Labor Costs, Labor Informality and Income Distribution in Colombia and Chile, 1984-2009[1]

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Abstract

The labor costs regulations such as the minimum wage, the contributions to social security and the payroll taxes has been the subject of intense debates and academic discussion because the distortions and inefficiencies they may cause on the labor markets. Colombia has one of the onerous labor regulations in the region both because of their relatively high minimum wage and the elevated contributions to social security and payroll taxes. Chile, in contrast, has a flatter structure of non wage labor costs with few labor costs different from the wage in charge of the employers. So as to determine the impact of labor costs on informality, size of the workplace and labor earnings we estimate a simultaneous model using three stage least squares for Colombia and Chile. After calculating the reduce form of the model we perform several simulations. We find that the changes in the labor regulations of the last two decades have deeply affected the functioning and outcomes of the labor markets. In the Chilean case such regulation has contributed to hinder informality among the non skilled workers, to incentive the placement of workers in relatively large firms being at the same time neutral in distributional terms. The Colombian labor regulation of the last 20 years has promoted informality among the non skilled, prompted formality among the skilled, confined the non skilled in small firms and deeply contributed to the rise of concentration of labor earnings.

Key words: Labor costs regulations, labor informality, minimum wage and size of workplace.

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Costos Laborales, Informalidad laboral y Distribución del Ingreso en Colombia y Chile,1984-2009[2]

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Resumen

Las regulaciones sobre el salario mínimo, las contribuciones a la seguridad social y los impuestos a la nómina han sido objeto de debate por sus implicaciones sobre el mercado laboral. Colombia se convirtió en años recientes en uno de los países con los costos laborales de ley más altos de la región. Chile, en contraste ha tenido periodos de flexibilización laboral que incluyen, entre otros, diferenciación de salario mínimo para jóvenes y reducciones de las cargas efectivas para las empresas. La regulación afecta en forma profunda el funcionamiento del mercado laboral impactando tanto los ingresos laborales como la informalidad laboral lo que tiene implicaciones significativas en la distribución del ingreso. Este trabajo intenta mostrar el impacto de la regulación sobre los resultados laborales para Colombia y Chile. Se estima un modelo de ecuaciones simultáneas para cada uno de los países para determinar el impacto de los costos laborales con cargo al empleador sobre la informalidad, y a través de esta sobre el tamaño del sitio de trabajo medido en número de trabajadores y los ingresos laborales. Con base en los resultados se muestra que parte de las diferencias en la distribución del ingreso entre Colombia y Chile están explicados, en parte, por las estructura de los costos laborales. Adicionalmente se presentan simulaciones sobre la distribución de los ingresos con base en cambios en los parámetros de costos laborales

Palabras claves: Regulación de los costos laborales, informalidad laboral, salario mínimo y tamaño de empresa.

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Content

1. Introduction

The informality of employment is one of the greatest problems that face the developing world. Informality is associated with low labor earnings, lack of protection to social security, low levels of technology and innovation bringing about inequality, poverty and social exclusion. A recent study of the OECD (2009) has pointed that "Informal is Normal" as an important proportion of the jobs in the developing world do not comply either with the labor regulation of the countries or the international standards such as those established by the International Labor Organization (ILO). The sources or causes of informality of employment are diverse and there exist an immense literature on the issue. One of the most studied factors linked to informality are labor regulations as they may turn from a mechanism to protect workers into a barrier that impede the creation of formal jobs.

The informality trends of Chile and Colombia have been quite different in the last twenty years. Chile has exhibited relatively lower rates of informality –around 35% measured by lack of contribution to pension system and a more narrow informality gap between skilled and non skilled workers than Colombia. In fact, in the latter country the informality rate has fluctuated around 50% -measured by the lack of social protection in health or pension or 60% taking only pension- yet the informality gap between skilled and non skilled workers has sharply widened as for the skilled workers it has dropped while for the non skilled it has augmented. Other differences in labor outcomes between Colombia and Chile are the size of the workplace and the earning gap formal/informal. In Chile a greater proportion of the labor force works in large firms while in Colombia the trend is the opposite. In Chile the earnings gap formal/informal has remained more or less constant while in Colombia it has broadened.

The aim of this paper is to determine the role of the labor costs –as the sum of wages and non wage cost in charge of the employer – on the informality rates, size of the workplace and the distribution of labor earnings in the last 25 years in Colombia and the last 20-years in Chile. In Chile the minimum cost of formal hiring comprised by the minimum wage and non wage costs associated to the minimum wage has grown mainly

as a result of the increase of the latter while non wage costs in charge of the employer have remained low. In contrast, Colombia has experienced increases both in the minimum wage and in no wage costs. We argue then that the bad and perverse performance of the Colombian labor outcomes vis a vis the Chile's ones are rooted in the differences of labor regulations of the two countries. Since the two countries offer such different experiences an analysis of them countries using the same methodologies and tools may help to discern the role of the regulations on the inefficiencies and distortions of the labor market.

This work is divided in eight sections being the first one this introduction. The second section describes the legislation and the evolution of labor costs for Colombia and Chile. The third section reviews some of the literature on the impact of labor costs and minimum wage on labor market outcomes, the fourth presents the data sources and the descriptive statistics for the two countries. The fifth section develops a simple theoretical model of labor costs and informality. The sixth explains the empirical model and presents its results while the seventh detailed the simulations undertaken. Finally section eight contains the conclusions.

2. Regulation of labor costs in Colombia and Chile

2.1 Colombia

The wage and non wage labor costs for Colombia can be divided in five components as follows: 1) the base wage whose legal floor is the minimum wage: 2) the contributions to social security in health and pension; 3) the insurance against workplace risks; 4) the payroll taxes (called parafiscales) to finance i) childcare for the poor through the Institute of Family Welfare, ii) technical training of the labor force through the National Service for Learning, iii) the family subsidy paid to the *Cajas de Compensacion;* 5) other wage and non wage costs such as severance payments, vacations, midyear and Christmas bonuses and transportation subsidy.

The minimum wage and the transportation subsidy are set every December through a government decree issued after labor unions and producers' organizations agree on the following year rise that depends upon past and expected inflation and productivity growth. As Graph 1 shows real minimum wage has risen 40% in real terms from 1984 to 2009 but it has had three cycles: from 1984 to 1986 when its index rose from 100 to 117 to fall to 107 in 1997 and to steadily grow to 140 in 2009.

As of social security, its most important change occurred with the Law 100 of 1993 that modified the health and pension systems. The Law 100 created two health systems: the subsidized and the contributive regimes[3]. The formal workers would belong to the latter that would pay a percentage of their wages to finance their health insurance (4%) and to save for their pensions (2%) in individual accounts. The employer would pay as well a percentage for health (8%) and for pensions (6%). The contributions to the social security system have experienced several modifications. In 1996 the contribution to pension increased to 10% (25% paid by the employee and 75% by the employer) and in 2003 the Law 797 ruled that it would rise gradually until 14% in 2006.

The payroll tax destined to finance public childcare centers (ICBF) was fixed in 2% by the Law 27 of 1974 and was raised to 3% in 1988. The payroll taxes to finance the national training system (SENA) and the family subsidy (Cajas de Compensación) were set in 2% and 4% by the Law 58 of 1963 and have remained unmodified since then.

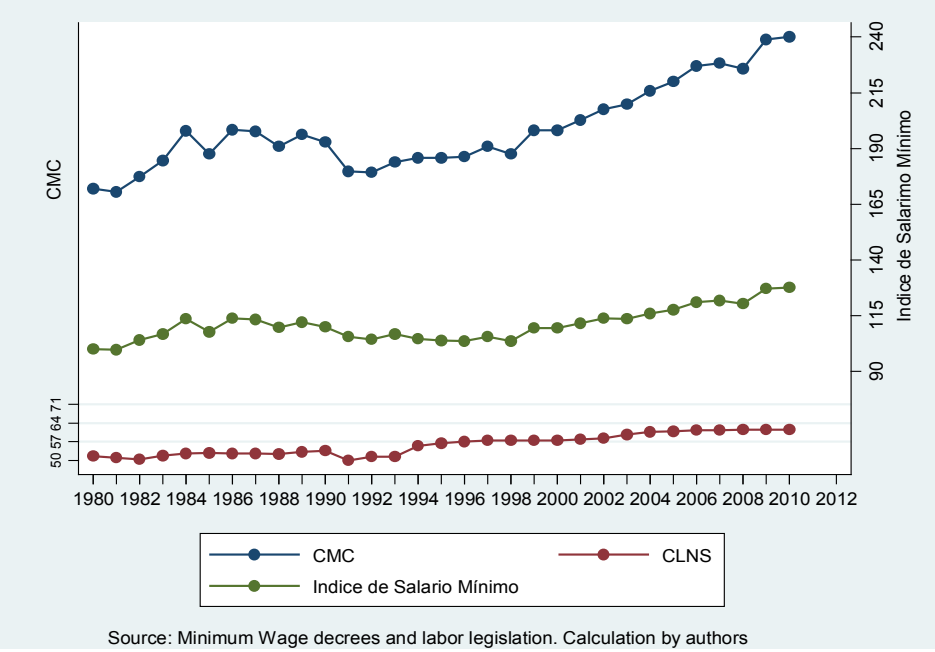
The Law 50 of 1990 reduced firing costs by modifying the so called "severance payments retroactivity ". The previous regulation established that the severance payment would be calculated using a base wage the very last one the worker was earning no matter how much higher was such last wage compared to the wages earned by the worker during her labor life in the firm. The Law 50 determined that severance payment at time t would be calculated using the wage at *t*, severance payments at *t-1* using the wages at *t-1*, etc. According to Lora and Henao (1995) the older regulation increased labor costs in average by 13.5%. The Law set in 8.3% the severance payment

[3] The Law 100 determined that 1 percentage point of the contribution would help to finance the subsidized regime. The rest of the resources come from the government Budget.

to be monthly deposited in individual accounts[4]. Other labor costs are comprised by midyear and Christmas bonuses (8.3%), vacation bonus (4.17%) and transportation subsidy (12% of the minimum wage) paid to the workers earning until two minimum wages and workplace risks (2.63%).

As a whole, social security contributions, payroll taxes and the other non wage labor costs paid by the employer made 52.2% of the wage in 1980, 50.6% in 1991 and 63.7% in 2009. After adding up the minimum wage and non labor costs we obtained the minimum costs of formal hiring. The index of costs has evolved from 152 to 178 from 1980 to 1986 and then fell to 160 in 1991. After that year the index progressively augmented and reached 228 in 2009 as shown in Graph 1.

Graph 1. Index of Minimum Cost of Formal Hiring for Colombia



Source: Minimum Wage decrees and labor legislation. Calculation by authors

2.3 Chile

In Chile the legal labor and non labor costs comprise four items: 1) the wage that has as a floor the minimum wage; ii) the contributions to social security for health and

[4] Kugler (2005) shows that with the introduction of the Law nearly 80% of the severance payment costs was transferred to the worker through a lower wage.

pension; iii) the insurance against workplace risks; 4) unemployment protection and severance payments[5].

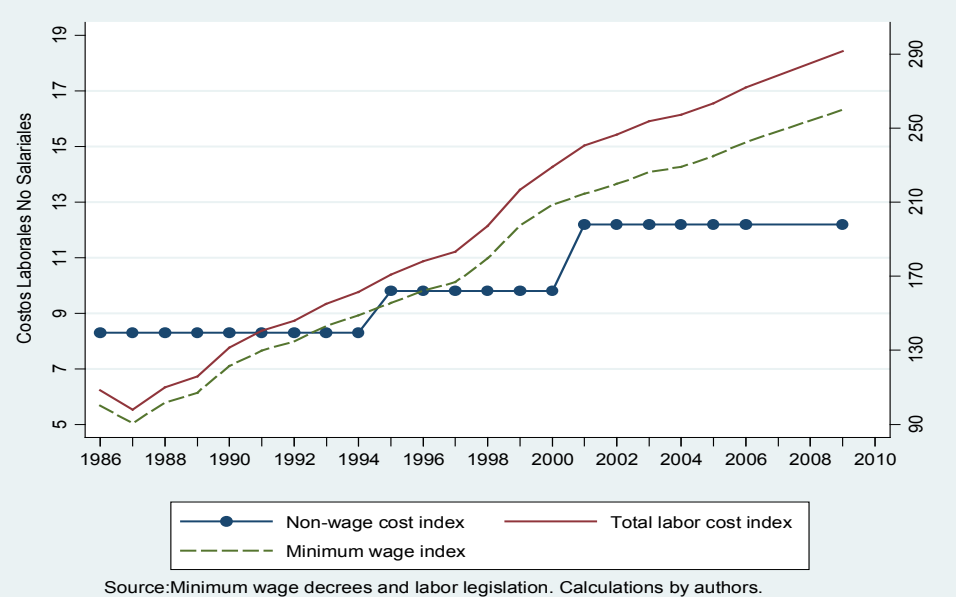
The minimum wage is established through a discussion among unions, government and employers taking into account past inflation and labor productivity. Graph 2 displays the evolution of the real minimum wage index (1986=100) showing that after the 1987's drop it has continuously increased to 259 in 2009. Chile introduced in 1989 a differential minimum wage for workers below 18 and above 65 years old fluctuating between 74% and 86% of the minimum wage.

One of the main institutional changes that affected Chilean labor costs was the privatization of the social security system ordered by the decree 3500 of 1980. Such decree reduced employer's contribution from 30% to 0%. At the same time, the decree determined that employees would pay 10% of their wages for pensions, 4% for health and 3% for disability insurance. In 1982 the Law 18.196 increased health contribution to 5% and then the Law 18.492 of 1985 to 7% paid entirely by the employee and has remained in that percentage since then. In 1987 the Law 18.646 raised the pension's contributions between 1% and 2% to finance the AFP's administrative commission. Thus, pension contribution reached 12% totally in charge of the worker.

In 1995, the Law 19.904 raised the disability insurance around 2%-4% for workers in "heavy labor", half paid by the employer and half by the employee. In 2001 the government created the unemployment insurance and fixed it in 3% of which 2.4 were paid by the employer and 0.6% by the worker (see Graph 2).

Graph 2. Index of Minimum Cost of Formal Hiring for Chile

[5] See: Dirección del trabajo. www.dt.gob.cl/



Source:Minimum wage decrees and labor legislation. Calculations by authors.

Chilean labor legislation during the dictatorship also changed in regard to firing costs. Thus, the decree 2.200 of 1978 established that in case of firing the employer would pay to the worker one monthly wage per each year of work in the firm until a maximum of 150 days. Such payment would not apply when the firing was on justified causes including among them economic problems of the firm. En 1990 the Law19.010 modified the decree and extended the severance payment until 330 days excluding the economic reason as a just cause of firing. Moreover, if the firm could not prove bankruptcy the worker should relieve an additional 20%. This latter percentage was increased to 30% by the Law 19.759 of 2001. As a whole, the non labor costs in charge of the employer increased from 8.3% to 12.2% during 1990-2009 although the largest modifications to labor regulations occurred during the 1970s and 1980s.

3. Literature on the impact of labor costs

The economic literature on the effects of labor regulations on labor market outcomes – demand for labor, unemployment, informality, wages- is quite large. Several works have found that such regulations have little or no impact (Card and Krueger 1995; Lemos, 2008; Farné 2010 among others) particularly in developed countries. However, Heckman and Pages (2004) compiled several studies for Latin America and found that the impacts of such regulations are negative or perverse in most cases mainly because such regulations bring about binding restrictions and distortions on the labor market. Likewise, Agénor (2005) focuses on the influence of government regulations on pay

and those related to job security and nonwage labor costs showing how those regulations may lead to segmentation of the labor markets.

Rigorous pieces of work have also been produce for the Colombia on this regard. Bernal and Cardenas (2004) estimated the long run labor demand elasticity to labor costs and deduced that 10% in labor costs would increase the labor demand between 1.5% and 5%. Vargas (2006) estimated that the social security contributions to health and pension would lower the numbers of hours worked particularly among women. Kugler and Kugler (2009) analyzed the impact of payroll taxes on the labor demand in the manufacturing sector and found that a 10% increase in such taxes would reduce between 4% and 5% labor demand. Mondragon-Velez et al. (2010) found that the rise of labor costs –both non wage and wage- increase the probability of transition to informality and the size of informality sector no matter its definition. Mejia and Posada (2007) examined the relationship between informality and degree of enforcement of the labor laws and found that an increase in labor taxes leads to a lower efficiency of production which could be seen as the social cost of informality. Arango et al (2009) found that there exists high sustituibility between skilled and non skilled labor and much less between labor as a whole and capital. They revealed that a permanent increase of 1% o minimum wage lowers in 0.33% the demand of non-skilled labor and raises in 0.3% that of skilled labor.

As of Chile, Gruber (1995) examined the impact in the manufacturing sector of the reduction of payroll taxes from 30% to 5% during the 1980s and found no effect on this reduction on employment as such reduction was fully passed on to workers in the form of higher wages. Edwards & Edwards (2000) found that a reduction of formal employment costs increases slightly real wages and lowers unemployment duration. That occurs because both sector cut down their differences in labor costs. Montenegro and Pages (2004) reviewed the vast Chilean experience of changes of labor regulations founding that job security provisions and minimum wage negatively affects employment for youth and non-skilled benefiting the older and skilled workers. Amodeu-Dorantes (2004) analyzed the relationship between informality and poverty in Chile revealing that household poverty increases in 3% and 6% the likelihood of having wages and salaries in the informal sector for male and female household heads respectively.

The impact of labor costs have been extensively studied by using the impact of the minimum wage. For instance Card and Krueguer (1995) found that minimum wage not always have perverse consequences on employment. Acemoglu (2001) shows that minimum wage combined with unemployment subsidy may in some case improve income distribution. In contrast, Neumark and Wascher (2008) stated that minimum wages reduced both employment opportunities for less skilled workers and earnings among the lowest skilled individuals. In addition, redistribute income among the low income families and may increased poverty. Besides it has longer run effects on labor earnings by hindering the acquisition of human capital. Nevertheless, the studies on the impact of minimum wages and labor costs for the developed world although may offer useful insights not are always pertinent for the developing world. In the USA's case – for instance- the minimum wage is relevant for a small proportion of the labor force.

Bell (1997) compared the effects of minimum wage in Colombia and Mexico during the 1980s founding that in former country minimum wage determines more strongly global wages hence its increase had a pronounced impact on disemployment for non skilled workers (between 2% and 12%). In contrast, in Mexico where minimum wage does not affect most wages its impact in employment outcomes was negligible. Maloney and Nunez (2004) showed for some Latin American countries that negative impact of minimum wage on employment is stronger the smaller its distance to the median wage.

The impacts of minimum wage and minimum costs of formal hiring on the distribution on earning also depend upon the localization of those costs with respect to the median or mean earnings. If a rise in labor costs increases earnings of non-skilled and poor more than it diminishes their employment inequality may improve. Comparing the cases of Brazil and Colombia Angel-Urdinola y Woodon (2003) showed that this is an empirical matter.

4. Data and Descriptive Statistics

4.1 Data

The objective of the present document is to determine the impact of the minimum costs of formal labor hiring on the formal/informal status of the workers and their labor

income. The worker's formal/informal status utilized here is based on the ILO's definition of informal employment that is concerned with the characteristics of the jobs, rather than the economic unit to which they belong. Thus, the criteria for defining informal unemployment are mainly that the jobs have no written contract and lack of social protection[6]. Thus, a worker not insured to health and not contributing to pensions through their job was classified as an informal worker. The health insurance and the pension contribution may be either deducted in full from the worker's payment as in Chile o paid by both the employer and the employee as in Colombia. For ILO the workers with public health insurance are informal.

For the Colombian case the data come from the Households surveys that had an informality section every two years in the second quarter from 1984 to 2000, then every year in the second quarter from 2001 to 2006 and with the implementation of the "Integrated Great Household Survey" every year during the whole year. The surveys contain cross sectional information among other on labor participation, social security, working unit size, education, hours worked, labor and non labor earnings and time working in the firm. The surveys covered the main 13 cities and their metropolitan areas.

For the Chilean case the data come from the Survey of Socio Economic Characterization (CASEN) carried out by the Ministry of Planning. The CASEN surveys have been implemented every two years from 1990 to 2000 and every three from 2003 to 2009. The Surveys have worker's information on affiliation to the health (sistema provisional) and pension through the job in addition to employment, labor earnings, education and the usual socioeconomic variables of the household.

4.2. Descriptive statistics

Table 1 and Table 2 contain the descriptive statistics of the evolution of informality for Colombia and Chile by firm size, level of education, age, gender, occupational position, earning gap and distribution of employment by firm size. The Colombia informality – as contribution to pensions through the job - has dropped from 60.77% from 1984 to 63.78% in 2009 increasing to 70.58% during the end of the century economic crisis to

[6] ILO (2003) warned on the need to harmonize the definition of informality based in its approach. The characterization of informality using a different definition more in line with the Colombian Statistical Office one is found in Bernal (2008), Flórez (2002) y Sánchez (2009).

start slowly falling until 2009. In the Colombia case, however, the most dramatic changes of informality have occurred by educational level (skills). Thus, the informality rate of workers with primary education o less remained around 73% until 1996 and then jumped to linger around 82.4%. The informality of workers with incomplete and complete high school have augmented the most from 74.0% to 86% and from 59.9% to 86.8% during 1984 to 2009 respectively. In contrast, the rate for workers with incomplete college or technical degree have rose from 36.0% to 44.7% from 1984 to 2002 and then dropped to 42.1% in 2009. As of workers with college degree Table 1 shows their employment informality was more or less constant around 38% and then fell continuously to 27% in 2009. The Colombian trends indicate that although informality has slightly reduced the informality gap by skill have actually widen as the least educated workers have become more and more informal.

The trends by age are quite similar having all a rise during the 2000 crisis and fall since then. The least informal workers are at ages 25 to 34 and the most the youngest and the oldest. The data also reveal that there are not differences in informality by gender. In regard to informality by firm size Table 1 shows that it has reduce itself for all four sizes being the most informal the person size (own account workers) that went down from 95.3% to 94.02% and the least informal the plus than 10 workers size that dropped from 22.9% to 15.24% during 1984-2009. As of employment by firm size Table 1 indicate that in 1984 26% of the workers belong to one person firms (own account workers) rising to 37% in 2000 falling a bit to 33% in 2009. In contrast, firms with more than 10 workers employed 41% of the labor force in 1984 and 37% in 2009.

Table 1 also pinpoints that the proportion of non skilled workers working in large firms has actually diminished. In fact, in 1984, 28% of the workers with primary education, 42% of those with incomplete high school and 60% of those with complete high school were employed in large firms (more than 11) By 2009 such percentage have dramatically decrease to 13%, 20.3% and 42% respectively. Unlike the trends described for non skilled the percentage of workers with college degree in large firms has remained constant in the last 25 years around 68%.

As of labor earnings Table 1 show that the wage gap between formal and informal workers has widened from around 1.4 in the 1984 to above 1.85 in the last decade.

Table 1. Descriptive Statistics of Colombia

Estadisticas descripticas de Colombia													
		1984	1986	1988	1992	1994	1996	1998	2000	2002	2004	2006	2009
Informality by health or pension definition	(%)	54.4	57.58	56.01	54.34	51.63	49.05	53.2	56.4	55.93	53.83	51.06	48.97
Informality by pension definition	(%)	60.77	63.19	62.12	61.17	57.29	64.89	65.16	69.1	70.58	68.06	64.47	63.78
Informality by education levels	Primaria o menos	74.0	77.1	76.5	76.3	73.9	82.4	83.9	87.5	88.4	88.5	86.2	86.8
	Secundaria Incompleta	59.9	63.4	63.1	64.7	62.4	72.7	75.1	79.1	82.5	88.5	86.2	86.8
	Secundaria	40.0	43.9	44.2	44.7	45.5	53.3	54.7	60.8	63.8	62.6	59.87	59.93
	Universitaria incompleta	36.0	37.9	39.4	40.3	38.2	41.7	42.3	46.7	50.1	45.8	42.8	42.1
	Superior o mas	38.7	40.1	40.3	41.4	38.9	32.0	30.4	32.6	33.7	30.5	29.4	27.0
Informality by age group	15-24	65.51	68.82	67.88	68.68	68.69	73.62	75.16	78.99	81.38	77.06	72.47	71.18
	25-34	52.37	55.01	54.49	52.84	55.15	59.29	59.95	63.69	65.29	61.85	56.5	54.74
	35-54	60.32	61.96	60.78	59.81	56.70	62.39	61.05	65.4	65.91	64.42	61.96	62.02
	55-64	71.97	73.98	70.31	70.59	70.73	71.21	72.66	76.7	77.58	76.4	74.14	75.95
Informality by gender	Hombre	60.44	62.87	61.93	60.69	58.09	65.95	65.76	69.67	70.1	68.05	63.96	62.69
	Mujeres	60.21	62.57	61.43	60.4	57.10	62.58	63.59	67.76	70.35	67.45	64.47	65.09
Informality by firm size	1 persona	95.33	96.52	95.37	93.52	90.86	91.53	91.16	94.1	94.74	94.5	94.09	94.02
	2 a 5 personas	85.8	86.23	85.64	84.18	79.2	83.42	83.22	85.44	89.43	88.27	86.59	86.99
	6 a 10 personas	60.24	64.21	62.49	63.33	59.47	67.19	63.97	66.75	69.52	69.37	64.69	62.42
	11 o mas personas	22.9	25.82	23.9	25.87	24.87	31.19	30.14	29.7	26.97	23.38	19.56	15.24
Distribution of employed by firm size	1 persona	26.02	26.9	26.58	26.35	28.06	28.27	33.44	37.13	35.68	34.19	34.20	33.11
	2 a 5 personas	24.89	25.09	25.29	24.62	21.19	22.45	22.88	23.46	25.58	24.68	23.95	23.52
	6 a 10 personas	7.76	8.3	9.32	8.31	8.06	7.9	7.29	6.51	6.52	6.36	6.92	5.74
	11 o mas personas	41.34	39.71	38.8	40.72	42.69	41.38	39.4	37.9	36.23	37.77	35.61	37.63
Percentage of employed by education levels on firms of 10 or more workers	Primaria o menos	27.92	25.74	24.56	24.45	25.96	23.56	18.55	14.27	12.29	12.6	13.41	13.19
	Secundaria Incompleta	41.99	39.69	37.02	37.8	39.52	35.8	27.77	24.71	19.83	19.85	21.19	20.82
	Secundaria	60.01	56.4	54.24	54.38	54.73	53.39	46.69	42.32	39.37	39.43	39.61	41.9
	Universitaria incompleta	69.51	66.87	63.45	64.76	63.37	63.49	59.4	55.43	52.38	53.89	53.8	61.39
	Superior o mas	68.19	66.44	66.76	67.49	67.91	69.63	66.0	63.67	66.1	66.82	66.83	70.11
Labor earning gap	[illegible]	1.44	1.44	1.39	1.41	1.57	1.73	2.04	2.11	2.18	2.11	1.94	1.85

Table 2 contains the descriptive statistics of informality –measured as contribution to pensions through the job- for Chile. According to Table 2 Chile's informality rate Chile was 35% in 1990 rose to 42% in 2002 and fell to 36% in 2009. By schooling the informality rate has increase for all groups. Accordingly, the rate for workers with basic education or less increased from 45% to 59% during 1990-2000 and the fell to 49% in 2009. The rate of workers with incomplete and complete high school rose during 1990-

2009 from 35% to 41% and from 26% to 29% respectively and the one of workers with incomplete and complete college went up from 17% to 22% and from 12 to 15%, respectively.

The informality rate by age dropped from 45% to 37% for the youngest groups -ages 15 to 24 and rose from 32 to 36% for the oldest –ages 35 to 54. By gender, women have had a slightly higher rate than men. As of informality by firm size Table 2 shows –like in the Colombian case- that it is higher in 1 person firms (own account workers) increasing from 62% to 72% from 1990 and 2009. Informality of workers in firms than 10 employees has also augmented from 12% to 16%. The percentage of workers working in 1 or 2-5 person firms has been more or less constant around 24% for the former and around 21% for the latter. On the other hand, workers in firms of 10 or more employees comprised 44% of the labor force in 1990 and 50% in 2009.

Table 2 shows that the percentage of workers with basic education and incomplete high school working in large firms –unlike Colombia- has augmented a bit from 33% to 37% and from 44% to 46% during 1990-2009, respectively. Similar trends are observed for workers with complete high schools and incomplete college or technical education having both elevated in 5 percentage points the participation of those workers in large firms. Finally, the percentage of workers with college education in large firms has fluctuated around 76% during the period under study. Unlike Colombia Chile has experienced no changes in the labor earning gap between formal and informal workers since 1990.

Table 2. Descriptives Statistics of Chile

		1990	1992	1994	1996	1998	2000	2003	2006	2009
Informality	(%)	35.02	39.95	41.1	39.87	41.6	46.21	42.92	36.77	36.85
Informality by education levels	Primary or less	45.6	51.8	53.3	53.9	55.0	59.4	56.2	49.6	49.4
	Incomplete High School	35.7	39.8	40.2	39.6	42.9	46.7	44.6	39.5	41.4
	High School	26.5	28.7	29.3	28.2	31.2	33.8	32.9	27.7	29.2
	Incomplete College or Tecnical education	17.7	18.9	19.9	19.2	21.5	24.3	23.9	21.4	22.6
	Complete College	12.0	14.3	11.8	15.0	15.6	16.7	15.7	15.3	15.7
Informality by age group	15-24	45.15	47.18	47.1	45.77	46.3	52.03	47.64	36.98	37.53
	25-34	30.14	34.64	34.4	33.43	35.7	39.79	36.64	29.5	30.29
	35-54	31.98	37.58	38.8	37.68	39.2	43.46	40.69	35.46	35.67
	55-64	39.19	46.29	47.2	48.45	49.3	54.58	49.97	44.27	42.67
Informality by gender	Men	34.42	40.1	41	39.43	40.9	46.05	42.33	33.59	35.12
	Women	36.44	39.54	41.3	40.85	42.9	46.57	44.14	39.12	40.08
Informality by firm size	1 person	62.74	74.16	76.8	75.83	74.6	77.25	79.44	74.72	72.07
	2 a 5 people	52.41	58.35	58.7	56.14	62.1	65.34	63.99	58.48	57.87
	6 a 10 people	33.26	36.85	33.3	32.24	36.5	38.67	36.7	33.16	32.31
	10 or more people	12.51	16.37	15.8	15.28	16.2	18.97	15.50	12.78	16.6
Distribution of employed by firm size	1 person	23.43	21.08	23.2	21.48	24	22.20	23.44	22.14	24.42
	2 a 5 people	22.74	24.47	24.9	24.51	22.7	27.17	25.13	21.81	18.77
	6 a 10 people	8.98	8.76	7.13	8.51	7.05	7.15	6.19	5.81	6.50
	10 or more people	44.85	45.7	44.8	41.5	46.2	43.48	45.25	50.24	50.31
Percentage of employed by education levels on firms of 10 or more workers	Primary or less	33.1	35.8	33.9	30.8	34.0	32.1	32.7	37.0	36.6
	Incomplete High School	44.2	45.5	45.4	40.9	44.0	43.5	43.3	47.7	45.6
	High School	52.8	53.4	53.8	48.6	55.1	53.0	53.8	58.7	57.6
	Incomplete College or Tecnical education	63.4	66.2	66.0	59.0	64.3	63.3	64.7	68.0	68.0
	Complete College	75.4	73.5	76.2	70.6	76.0	74.6	76.0	78.4	77.2
Labor earning gap	$\frac{\text{wage formal workers}}{\text{wage informal workers}}$	1.22	1.24	1.26	1.25	1.24	1.28	1.30	1.28	1.26

From the descriptive statistics it can be observed that in Colombia non skill workers have become increasingly informal and have moved to the small firms and workplaces as the earnings gap has augmented while in Chile there has been a slight rise in informality for all workers accompanied with a shift of non skill workers from small to large firms. The next section will develop a simple theoretical able to explain the role of rise of labor costs in the labor markets outcomes of both countries observed in the descriptive statistics.

5. A simple model of informal employment, labor costs and labor earnings

5.1 Production

An economy produces a homogenous good Y with two types of technologies. Let us call F the technology used in the "formal sector" that combines skilled and non skilled labor -L_s, L_{ns} and relatively high levels of capital K_F and modern technology to produce Y_F. This sector complies with the regulation established in the labor legislation as it pays the social security contribution of their workers and the different taxes including the payroll

ones. The base wage that a particular worker may earn in this sector is at least the legal minimum wage. The other type of technology called I combines non-skilled labor L_{ns} with relatively low levels of capital K_I and "backward" technology to produce Y_I. In this sector, the workers are "informal" as they have no social protection through their jobs and the firms evade the payroll and other taxes. The wages paid in this sector are fixed by demand and supply and may be lower than the legal minimum wage. Thus, the production of each sector and the total one may be represented as follows:

$$Y_f = Y_f(L_s L_{ns} K_F) \quad (1) \qquad Y_i = Y_i(L_{ns} K_I) \quad (2) \qquad Y = Y_F + Y_I \quad (3)$$

5.2 Labor Market

The supply of skill labor L_s^O is a function of the skill labor wages W_s while the demand for skilled labor L_s^D results from the cost minimization of the formal firms subject to the .formal technology. The supply of non skilled labor L_{ns}^O depends positively of the wages of non skilled workers W_{ns} while the demand for non skilled workers L_{ns}^D comes from the cost minimization of the formal and informal firms. It should be clarified that in this simple model "wages in the formal sector mean the total labor costs comprised by wage and non wages costs as presented above. Thus, the labor market equilibrium may be represented as follows:

$$L_s^{DF}(W_{ns}, W_{s,} K_F) = L_s^O(W_s) \quad (4)$$

$$L_{ns}^{D,F}(W_{min,} W_s, K_F) + L_{ns}^{D,I}(W_{ns,} K_I) = L_{ns}^O(W_{ns}) \quad (5)$$

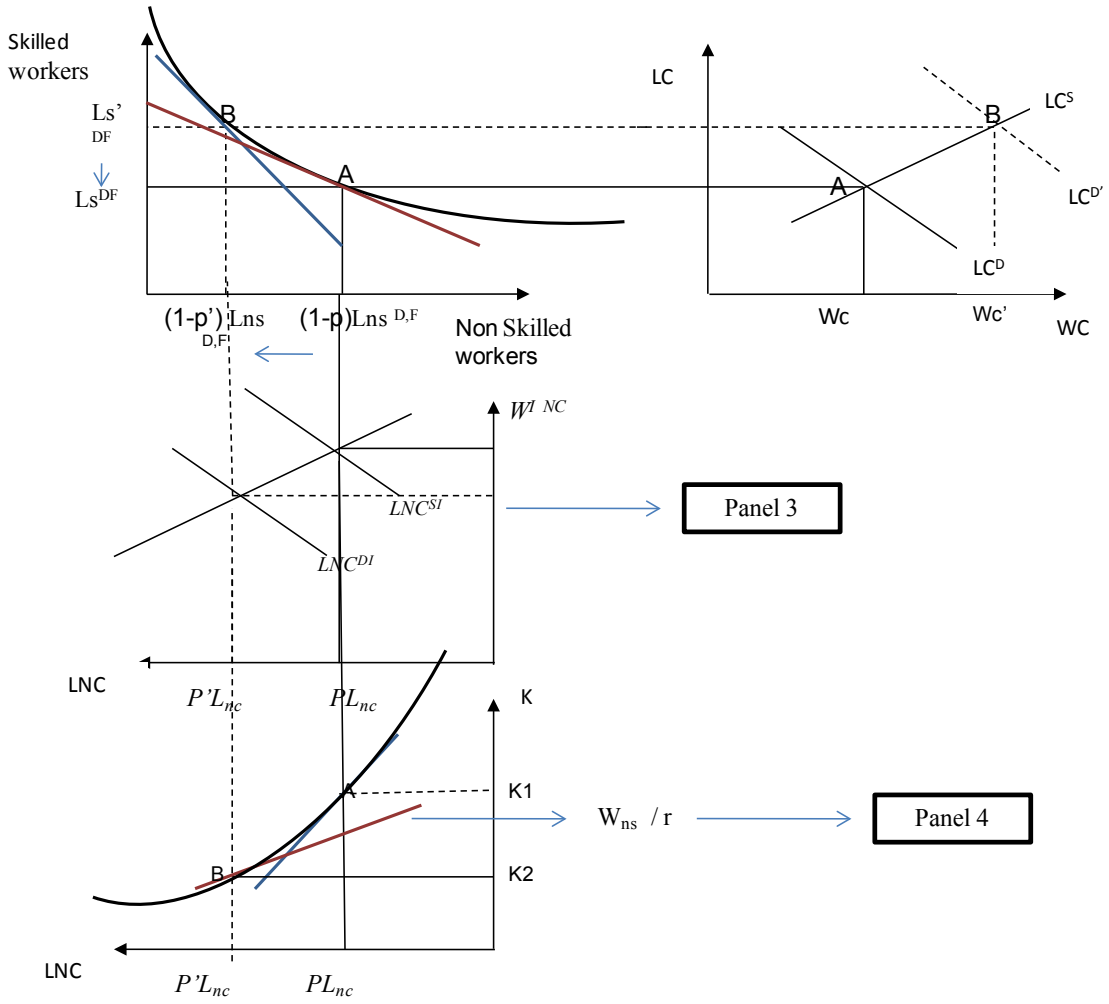
5.3 Comparative Statics

The equilibrium of the labor markets of the skilled and non skilled workers and the cost minimization of the formal and informal firms are depicted in the diagram 1 that shows graphically the comparative statics of a change in the minimum labor cost of formal hiring (either by a rise in the minimum wage or in the non wage costs). Panel 1 illustrates the cost minimization labor demand of skilled and non skilled workers in the formal sector. Point B is the cost minimizing demand of skilled $L_s^{D,F}$ and non skilled

workers $L_{ns}^{D,F} = (1-\rho_0) * L_{ns}^{D}$ of the firms in the formal sector**,** ρ_0 stands for the fraction of the non skilled workers employed in the formal sector. We assume that non skilled workers are paid the minimum wage plus the minimum non wage costs associated with the minimum wage and hence the slope of the line cost is equal to - W_{min}/W_s. We also assumed for simplicity that the elasticity of substitution between labor and capital in the formal sector is zero. Panel 2 contains the labor market of skilled workers in which L_s and W_s represent the initial equilibrium. Panel 3 shows the labor market of the non skilled workers in the informal sector. The equilibrium corresponds to the quantity $\rho_0 * L_{ns}^{D}$ and to wage W_{ns}.

Finally, point *N* in Panel 4 depicts the cost minimizing combination of non skilled labor and K_I in the informal sector. The slope of the cost line would be equal to W_{ns}/r where *r* is the price of capital and it is assumed to be exogenous.

Panel 1 **Panel 2**



Let us assume that the legislation established higher minimum costs of formal hiring elevating W_{min} to W_{min}'. The new cost minimizing demand of skilled and non skilled labor is point M' bearing an increase of the demand for skilled labor from $L_s^{D,F}$ to $L_s^{D,F}$, and their wages from W_s to W_s'. In contrast, the demand of non skilled labor in the formal sector shrank to $(1-\rho_0^{'})^* L_{ns}^{D}$. Such demand reduction would lead to a greater supply of non skilled workers in the informal sector lowering their wages to W_{ns}'. The new cost minimizing combination of non skilled labor and capital in the informal sector would be N' in which "backward" capital has been replaced by non skilled labor probably reducing even more the size of the informal firms.

The comparative statics of a rise of the minimum costs of labor hiring entails the following results:

- Widening of the wage gaps between the formal and informal workers.

Thus $W_s'/W_{ns}' > W_s/W_{ns}$ and $W_{min}'/W_{ns}' > W_{min}/W_{ns}$.

- Reduction of size (less capital) of the informal sector firms

Such results may imply a deterioration of the distribution of labor earnings and greater exclusion of the informal workers from the modern technology and innovation.

5.4 An example

The following equations describe the labor markets of the skilled and non skilled workers.

Demand for skilled workers: $L_s^{D,F} = \beta * W_{min} - \alpha * W_s$

Demand for formal non skilled workers: $L_{ns}^{D,F} = (1-\rho_0)* L_{ns}^{D} = \theta * W_{min}$ Demand for informal non skilled workers: $L_{ns}^{D,I} = \rho_0 * L_{ns}^{D} = \zeta * W_{ns}$

Supply of skilled workers: $L_s^{O} = \gamma * W_s$

Supply of informal non skilled workers: $L_{ns}^{O} = \eta * W_{ns}$

Where $\beta, \alpha, \gamma, \eta > 0$ and $\theta, \zeta < 0$

Equilibrium in the labor market of skilled workers imply that, on the one hand $Ws = \beta * W_{min}/(\gamma + \alpha)$ and, on the other, that $\delta W_s/\delta W_{min} = \beta/(\gamma + \alpha) > 0$ which means that a rise in the minimum cost of formal hiring bears an increase of the skilled labor wages. By the same token, the rise in the minimum cost of formal hiring lowers the demand of non skilled workers in the formal sector as $\delta L_{ns}^{D,F}/\delta W_{min} = \theta < 0$.

It is assumed that the laid off formal non skilled workers would increase the supply of informal non skilled workers. In consequence in equilibrium $L_{ns}^{O} = L_{ns}^{D,F} + L_{ns}^{D,I}$ or $\eta * W_{ns} = \zeta * W_{ns} + \theta * W_{min}$. It implies that the equilibrium non skilled wage would be $W_{ns} = \theta * W_{min}/(\eta - \zeta)$. Therefore $\delta W_{ns}/\delta W_{min} = \theta/(\eta - \zeta) < 0$ showing that a rise in the minimum costs of formal hiring will reduce the wages of the informal workers.

6. Simultaneous equation model of informal employment, firm size and labor earnings

6.1 A conceptual explanation

For a particular worker the informality of the employment, the size of the workplace and the labor earnings are determined simultaneously. In this respect, it is needed an empirical model that allows grasping such simultaneity. Hence, the model should be able to capture the relationship between the variables related to labor regulation and labor outcomes:

The *ratio* between the expected labor earnings of a particular worker if she were formal and the minimum costs of formal hiring determines the probability of becoming informal. It is expected that the link between that *ratio* and informality is not linear. The expected labor earning in a formal employment is just what the average earnings of a formal worker with a given human capital and experience in a particular city and year. The minimum costs of formal hiring are the sum of the legal minimum wage and the contributions to social security, payroll taxes and the rest of non labor costs associated to the minimum wage. Thus, the higher the ratio the lower the probability of having an informal employment. For instance, if for a particular worker the *ratio* is lower than 1 it means that the minimum costs of formal hiring are greater than the expected productivity of that worker as a formal employee and hence the worker's probability of becoming informal would be larger in comparison to another worker with greater expected productivity.

If the worker exhibits high probability of being informal she would join small firms (or one person firms for own account workers) where it is more difficult being detected violating labor laws. These firms yet are relatively low capital intensive, lack productivity and innovation and, in consequence, their workers are relatively less productive.

Insofar a worker joins a small firm with low productivity and innovation her labor earnings would be lower than the earnings she would receive in a large and more productive firm in compliance with the legal labor regulations.

When the minimum costs of formal hiring are raised the *ratio* explained in a) would diminish increasing the probability of becoming informal for all workers. Nevertheless that probability would augment more for those workers with lower *ratio*.

Thus, the empirical model should allow the simultaneous estimation of the probability of being informal, of belonging to a large firm and the worker´s labor earnings. .

6.2 The empirical model

The expected labor income of a formal worker *i* is defined as the predicted labor earnings using the coefficients obtained from a Mincer's equation estimated only for formal workers. The estimated equation is as follows:

$$L_{wi} = \beta_0 + \beta_1 * Age + \beta_2 * Age^2 + \beta_3 * Educ + \beta_{4t} * D_{Educ12-15} + \beta_{5t} * D_{Educ16} + \beta_k + \beta_t \quad (1)$$

The equation specification contains the usual coefficients of age and education, premiums for incomplete -β_{4t} and complete college -β_{5t} that change over time, fixed effects for city β_k and year dummies β_t. The expected formal labor earnings are calculated using the βs estimators for all workers both formal and informal

The minimum costs of formal hiring a time *t* are equal to the legal minimum wage plus the social security contributions, the payroll taxes and the rest of non-labor costs established in the legislation currently in force. Thus, the minimum costs of formal hiring are defined as:

$$MCFH_t = W - MIN_t * (1 + PERC - NCL_t) \quad (2)$$

$MCFH_t$ stands for minimum costs of formal hiring, *W-MIN*$_t$ for the minimum wage and *PERC-NLC*$_t$ for the percentage of non labor costs. Thus, the *ratio* that negatively affects the probability of becoming an informal worker is $\left(\frac{W_t^{e-formal}}{MCFH_t}\right)$which is the expected

formal labor earnings divided by the minimum costs of formal hiring currently in force. As the probability of becoming informal is greater the worker would join firms of relatively smaller size and lower productivity and only capable of paying wages below the minimum costs of formal hiring. In this regard, informality status, firm size and labor earnings are determined simultaneously and, in consequence, so as to comprehend their multiple relationships it is required a system of equations that take into account such simultaneity. The simultaneous systems are the following:

- **Equation of Informality**

$$Informality_i = f\left(Firm\ size_i, \left(\frac{W_t^{e-formal}}{MCFH_t}\right), \left(\frac{W_t^{e-formal}}{MCFH_t}\right)^2, control\ variables\right) \quad (3)$$

- **Equation of firm size**

$$Firm\ size_{\boldsymbol{i}} = h(informality_i, W_{i,} PERC_{j,k}^{+10}, control\ variables\ ) \quad (4)$$

- **Equation for Labor Earnings**

$$L_{Wi=m(Firm\ size_{i,} Schooling\ years_i, age_{i,}\ age_i{}^2, control\ variables} \quad (5)$$

Where *Informality*$_i$ is a dicotomous variable equals to 1 if the worker i is informal and 0 otherwise, *Firm size*$_i$ stands for the firm size of the workplace and is equal to 1 if the firm has 10 or more workers and zero otherwise, Lw_i is the natural log of the labor earnings of worker *i*. The right hand side variables include the exogenous variables plus control variables such as educational level, age range, households characteristics and city or region fixed effect and year dummies. Since the estimation to be undertaken is of a system of equations the identification of the structural parameters depends upon the compliance of the order and rank conditions. The order condition requires that the number of exogenous variables omitted from the equation *m* must be equal or greater than the number of endogenous variables that appear on the right hand side of the equation *m* (after checking the exclusion restrictions). These Z_m variables serve as

instruments of the endogenous variable Y_m in the equation where Y_m is used as independent variable.

The three equation model fulfills the order conditions since the number of exogenous variables excluded in each equation is at least equal to the number of endogenous variables appearing in the right hand side of the equation (Wooldridge, 2006). Thus, in the informality equation that has *firm size* on the right hand side are excluded years o schooling, age, age2 and the percentage firms with more than 10 workers in the sector and city. The firm size equation excludes the variables age, age2 $\left(\frac{W_t^{e-formal}}{MCFH_t}\right), \left(\frac{W_t^{e-formal}}{MCFH_t}\right)^2$ and. Finally, the logarithm of labor earning equation omits $\left(\frac{W_t^{e-formal}}{MCFH_t}\right), \left(\frac{W_t^{e-formal}}{MCFH_t}\right)^2$ and the percentage firms with more than 10 workers in the sector and city.

6.3 Empirical Results

Table 3 shows the results of the estimation for Colombia of the simultaneous model of equations (3) to (5). The coefficients of the exogenous variables or instruments are statistically different from zero and have the expected signs. The results for the informality equation in the simultaneous model indicate that the higher the ratio $\left(\frac{W_t^{e-formal}}{MCFH_t}\right)$the lower the probability of becoming informal. Thus is such ratio increase in one unit the linear probability of being informal reduces itself in 0.067. The positive sign of quadratic term reveals that the negative effect is lower as the ratio turns larger.

The coefficients also show that the impact of ratio $\left(\frac{W_t^{e-formal}}{MCFH_t}\right)$ is different for level of education (column 1). Workers with incomplete and complete high school face a stronger effect of the variable $\left(\frac{W_t^{e-formal}}{MCFH_t}\right)$on their probability of becoming informal than those workers with complete college. For the latter the linear and quadratic impacts are close to zero (-0.067+ 0.061) and (+0.0108-0.0099). The coefficient of the percentage of workers in firms with more than 10 workers indicates that the probability of getting a job in a large firms augments the higher is the density of such type of firms in the city.

The estimators of the earnings equation show that the variables schooling years, age and age square determine –as expected- variations in labor income.

As of the endogenous variables effects the coefficients reveal that firm size and informality status are simultaneously determined. Thus, higher probability of working in a large firm is associated with less probability of having an informal employment and the other way around (columns 1 and 2 in Table 3). At the same time, large firms are associated with higher labor earnings. The results show that workers of large firms earn in average 17% more than those in small ones (column 3).

The coefficients of the exogenous variables for the Chilean case are similar to Colombia's (Table 4). Thus, the ratio $\left(\frac{W_t^{e-formal}}{MCFH_t}\right)$ has a negative impact on the probability of becoming an informal worker (column 1). Thus, if such ratio grows one the probability of having an informal job diminishes in 0.07 but its impact vanishes for large *ratios* as the quadratic coefficients suggests. The interaction of $\left(\frac{W_t^{e-formal}}{MCFH_t}\right)$, with labor skills are akin to Colombia's. Accordingly, for workers with complete college the impact of $\left(\frac{W_t^{e-formal}}{MCFH_t}\right)$on informality would be lower (-0.07+0.033) than for workers with complete high school or less (column 1).

The coefficients of the endogenous variables point as in Colombia that in large firms the probability of being an informal workers is lower (column 1 Table 4) and that the being informal is negatively associated with large firms. Finally, the larger the firm size the greater the labor earnings (column3 Table 4).

Table 3 Results for Colombia

VARIABLES	(1) Strong informality	(2) Size(+10 or more)	(3) lnw
Size(+10 or more)	-0.834***		0.375***
	(0.00352)		(0.00807)
W_i^e/MCF	-0.0671***		
	(0.00656)		
$(W_i^e/MCF)^2$	0.0108***		
	(0.00210)		
(W_i^e)/MCF*high school	-0.0132*		
	(0.00763)		
(W_i^e)/MCF*incomplete high school	-0.00145		
	(0.00814)		
(W_i^e)/MCF*incomplete collegue	0.0237***		
	(0.00896)		
(W_i^e)/MCF*collegue	0.0610***		
	(0.00717)		
$((W_i^e)$/MCF*high school$)^2$	0.00450*		
	(0.00236)		
$((W_i^e)$/MCF*incomplete high school$)^2$	0.00292		
	(0.00232)		
$((W_i^e)$/CMC*MCF*incomplete collegue$)^2$	-0.00374		
	(0.00235)		
$((W_i^e)$/MCF*collegue$)^2$	-0.00993***		
	(0.00212)		
Strong informality		(0.00644) -1.113***	
		(0.00588)	
lnw		-0.0429***	
		(0.00200)	
Proportion of firm(+10 or more workers)		0.0763***	
		(0.00445)	
Years of schooling			0.0689***
			(0.000874)
Age			0.0693***
			(0.00109)
Age_square			-0.000644***
			(1.29e-05)
Constant	0.942***	1.500***	10.91***
	(0.0202)	(0.0372)	(0.0422)
Observations	474098	474098	474098
R-squared	0.361	0.175	0.386
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1			

Table 4. Results for Chile

VARIABLES	(1) Strong Informality	(2) size(+10 or more)	(3) lnw
size(+10 or more)	-0.701*** (0.00453)		0.281*** (0.00882)
W_i^e/MCF	-0.0699*** (0.00431)		
$(W_i^e/MCF)^2$	0.00732*** (0.00112)		
(W_i^e)/MCF*hig school	-0.00677 (0.00705)		
(W_i^e)/MCF*incomplete high school	0.000838 (0.00617)		
(W_i^e)/MCF*incomplete collegue /Tecnical education	0.0424*** (0.00485)		
(W_i^e)/MCF*collegue	0.0338*** (0.00538)		
$((W_i^e)/MCF*hig\ school)^2$	0.00311* (0.00165)		
$((W_i^e)/MCF*incomplete\ high\ school)^2$	0.00211 (0.00138)		
$((W_i^e)/MCF*incomplete\ collegue/Tecnical\ education)^2$	-0.00570*** (0.00115)		
$((W_i^e)/MCF*collegue)^2$	-0.00522*** (0.00115)		
Strong informality		-1.053*** (0.00648)	
lnw		-0.0749*** (0.00197)	
Proportion of firms(+10 or more workers)		0.247*** (0.00564)	
Years of Schooling			0.0566*** (0.000644)
Age			0.0386*** (0.00110)
Age_square			-0.000221*** (1.24e-05)
Controls by year	yes	yes	yes
Controls by education	yes	yes	yes
Controles by ages	yes	yes	yes
Controls by cities	yes	yes	yes
Constant	0.800*** (0.0165)	1.614*** (0.0319)	10.22*** (0.0334)
Observations	536211	536211	536211
R-squared	0.193	0.058	0.279
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1			

7. Reduced Form Coefficients and Simulations

From an econometric point of view the impact of the minimum costs of formal hiring on the labor market outcomes may be determined using the structural form whose results were already explained by calculating the reduced form coefficients. The latter presented in Table 5 allow expressing the system of equations exclusively in terms of the exogenous variables and the controls (Woolbridge, 2006). After calculating the reduced form coefficients it will be feasible to calculate the long effect of the exogenous variables – particularly the minimum cost of formal hiring- on the three endogenous variables (see appendix 2 for the explanations of the reduced form coefficient calculation).

Table 5. Reduced Form Coefficients for Colombia

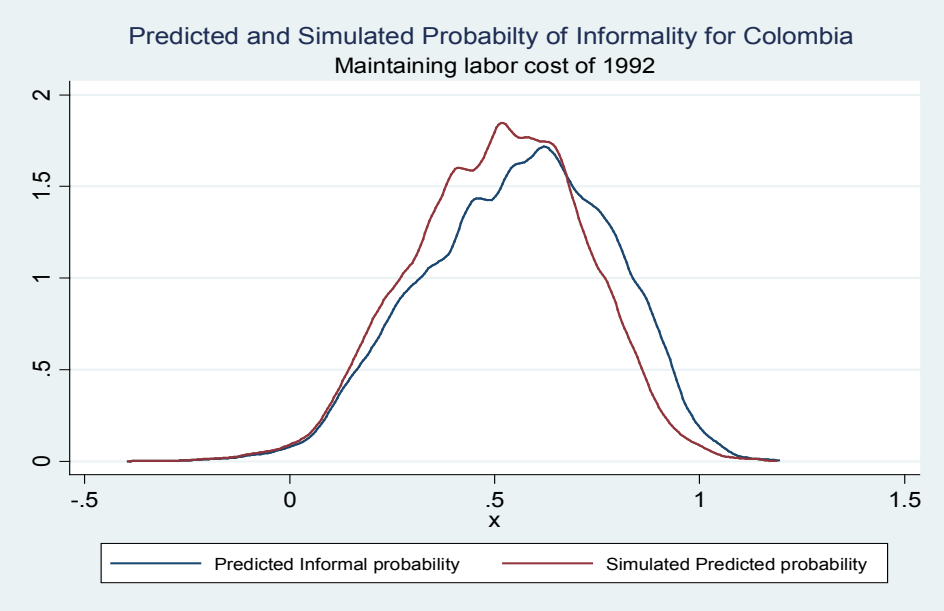
VARIABLES	Informality	Firm Size	Ln w
W_i^e/MCF	-0.782	0.857	0.321
$(W_i^e/MCF)^2$	0.126	-0.138	-0.052
(W_i^e)/MCF*high school	-0.154	0.168	0.063
(W_i^e)/MCF*incomplete high school	-0.017	0.018	0.007
(W_i^e)/MCF*incomplete collegue	0.277	-0.303	-0.114
(W_i^e)/MCF*collegue	0.710	-0.778	-0.292
$((W_i^e)$/MCF*high school$)^2$	0.052	-0.057	-0.022
$((W_i^e)$/MCF*incomplete high school$)^2$	0.034	-0.037	-0.014
$((W_i^e)$/MCF*incomplete collegue$)^2$	-0.044	0.048	0.018
$((W_i^e)$/MCF*collegue$)^2$	-0.116	0.127	0.047
Proportion of firm(+10 or more workers)	-0.729	0.874	0.328
Years of schooling	0.0282	-0.0338	0.056
Age	0.0284	-0.0340	0.057
Age_square	-0.0003	0.0003	-0.0005
Constant	1.097	-0.186	10.839

Thus, the reduced form estimation throw coefficients π_i that are a non linear combination of the structural parameters already estimated. The interest of this work is to determine the effects of the changes of minimum costs of formal hiring on the trajectory of three endogenous variables: informal employment, firm size and labor earnings and their distribution. So as to determine the effects of the regulation regarding the minimum costs of formal hiring in the trajectory of the endogenous variables some simulations were undertaken. Thus, it is calculated the informal employment, the size

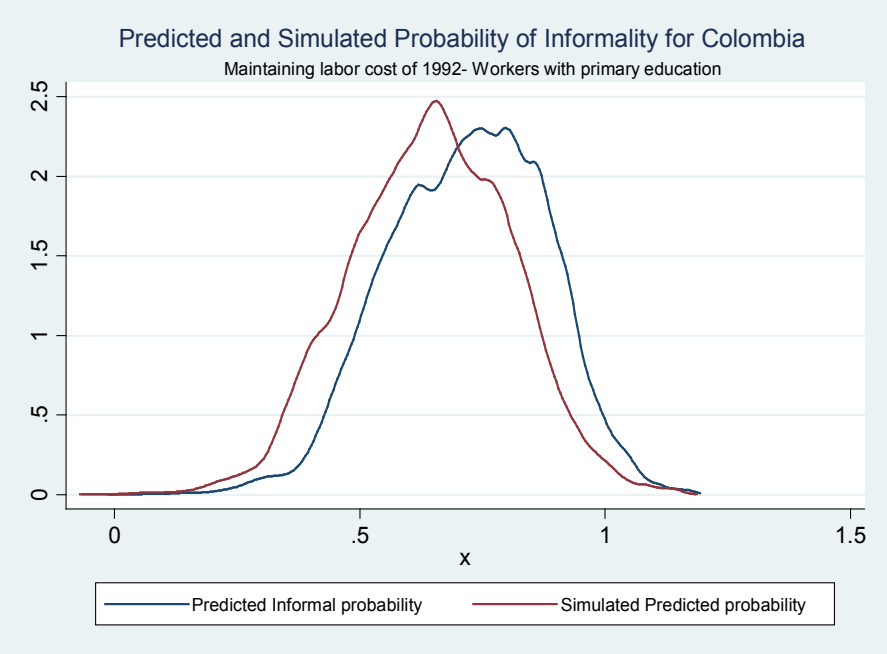
of the workplace and distribution of labor income would have been had the minimum costs of hiring stayed the same as the ones observed in 1992.

The results of the simulations are presented Graph 3 and Graph 4. Graph 3 shows the distributions of the observed and simulated linear probabilities of informality. It is clear that the entire distribution moves to the left. A *t* test for the difference in the mean of the simulated and the observed suggests that the informality would have been 7 points lower had the minimum costs of hiring remained unchanged since 1992. Nevertheless, the difference for workers of primary education reaches 13 points (Graph 4), while for the workers with college degree only 3 points. Hence, it is apparent that the increase of the minimum costs of formal hiring has negatively affected the most the non-skilled workers.

Graph 3. Predicted and Simulated Probability of Informality for Colombia

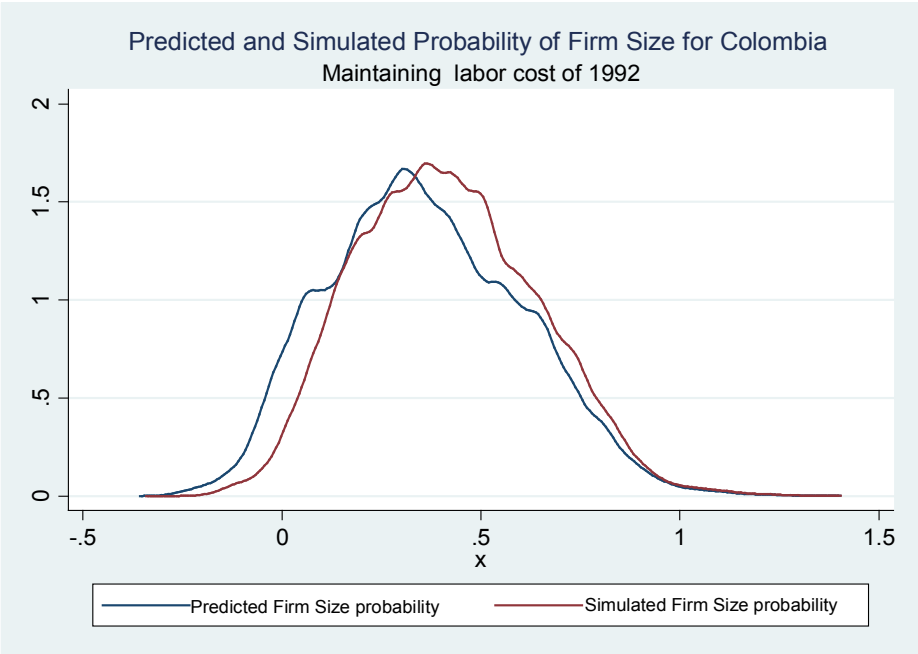


Graph 4. Predicted and Simulated Probability of Informality for Colombia (Maintaining labor cost of 1992)



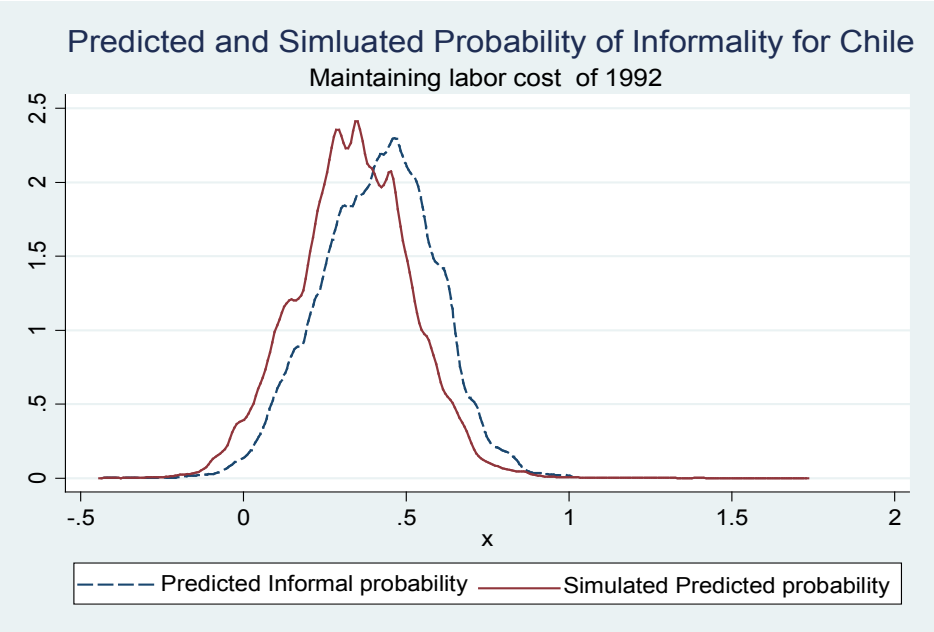
As of the size of the firm the simulations of Graph 5 indicate that percentage of employees working in firms of more than 10 workers would have been 6 points higher had the minimum costs of formal hiring kept unmodified since 1992.

Graph 5. Predicted and Simulated Probability of Firm Size for Colombia (Maintaining labor cost of 1992)

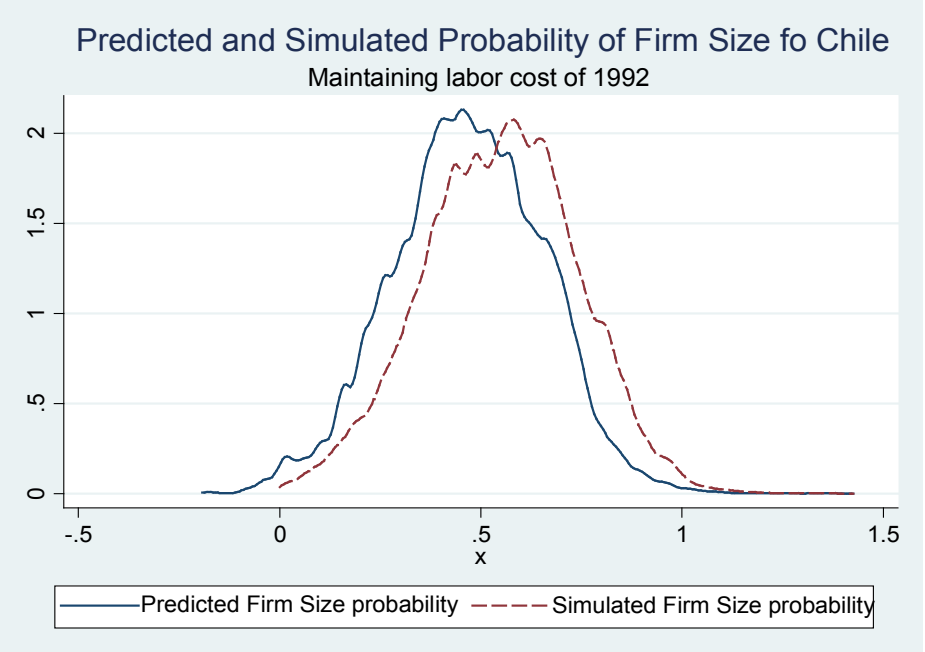


In the case of Chile the impacts are much smaller than in Colombia. For instance, had the rise of the minimum costs of formal hiring remained unchanged since 1992 informality would have been only 0.02 lower and the amount of worker in large firms 0.01 percentage points higher (see Graph 6 and Graph 7).

Graph 6. Predicted and Simulated Probability of Informality for Chile



Graph 7. Predicted and Simulated Probability of Firm Size for Chile



Finally, we simulate the impacts on distribution of labor earnings. As the theoretical model predicts the increase in minimum costs of formal hiring augments the concentration of labor earnings for the Colombia case. Table 6 had minimum costs of formal hiring remained constant the Gini coefficient would have been one point lower during 1992-2000 and three points lower during 2002-2009. This is a sizeable impact. Performing the same simulation exercises for Chile we observe no difference between the simulated and observed Gini coefficients (see Table 7).

Table 6. Simulations of informality and firma size for Colombia.

	Informality		t of difference	Firm Size		t of difference
1992-2000	Observed	Simulated		Observed	Simulated	
Total	64.2	61.7	423.3	38.26	41.0	-420.0
Primary	81.9	77.3	424.8	20.6	24.7	-422.0
Incomplete High School	71.7	68.5	363.7	32.2	35.7	-360.0
High School	53.3	51.5	196.8	48.9	51.0	-200.0
Incomplete Collegue	42.0	40.8	73.6	60.1	61.4	-73.4
Collegue	35.3	33.2	-110.0	66.6	65.9	105.9
2002-2009						
Total	65.8	58.3	590.3	33.7	41.99	-590.0
Primary	87.2	73.7	917.6	12.6	27.4	-920.0
Incomplete High School	80.7	70.8	531.5	19.9	30.8	-530.0
High School	61.0	56.0	268.8	39.1	44.6	-270.0
Incomplete Collegue	44.1	38.1	260.7	54.6	63.2	-260.0
Collegue	29.7	29.9	-33.3	66.7	66.5	35.3

Table 7. Simulation of the impact on distribution of labor earnings for Colombia

Años	Gini observado	BOOSTRAP ERROR GINI OBSERVADO	Gini_simulado	BOOSTRAP ERROR GINI SIMULADO
1992	0.501		0.501	
1994	0.564	0.0068	0.560	0.00155
1996	0.549	0.0092	0.548	0.00123
1998	0.545	0.0036	0.540	0.00117
2000	0.515	0.0040	0.508	0.00115
2002	0.523	0.0025	0.513	0.00126
2004	0.519	0.0027	0.508	0.00108
2006	0.499	0.0026	0.486	0.00097
2008	0.508	0.0079	0.492	0.00107
2009	0.462	0.0044	0.445	0.00080
Promedio (1992-2002)	0.535		0.531	
Promedio (2002-2009)	0.502		0.489	

Table 8. Simulations of informality and firma size for Chile.

	Informality		t of difference	Firm Size		t of difference
1992-2000	Observed	Simulated		Observed	Simulated	
Total	40.7	37.2	495.6	44.89	48.5	-500.0
Primary or less	53.5	49.4	412.6	33.8	38.1	-410.0
Incomplete High School	40.8	37.4	220.4	44.3	47.7	-220.0
High School	29.5	27.0	188.7	53.1	55.8	-190.0
Incomplete College or Tecnical education	20.1	17.1	152.1	64.2	67.2	-150.0
Complete College	14.3	12.5	46.4	74.6	76.4	-46.6
2003-2009						
Total	40.5	39.2	665.2	47.1	57.8	-660.0
Primary or less	53.7	37.6	230.0	34.2	51.8	-230.0
Incomplete High School	43.0	36.1	180.8	44.8	51.9	-180.0
High School	30.5	26.8	109.9	55.9	59.7	-110.0
Incomplete College or Tecnical education	22.9	12.6	418.3	66.1	76.6	-410.0
Complete College	15.8	9.0	91.1	76.8	83.9	-91.4

Table 9. Simulation of the impact on distribution of labor earnings for Colombia

Años	Gini observado	BOOSTRAP ERROR GINI OBSERVADO	Gini simulado	BOOSTRAP ERROR GINI SIMULADO
1990	0.553	0.00443	0.55198	0.00189
1992	0.561	0.00372	0.56103	0.00154
1994	0.556	0.01064	0.55671	0.00135
1996	0.553	0.00336	0.55534	0.00127
1998	0.559	0.00417	0.56360	0.00128
2000	0.555	0.00293	0.56104	0.00107
2003	0.554	0.00396	0.56212	0.00090
2006	0.527	0.00298	0.53435	0.00092
2009	0.515	0.00251	0.52351	0.00097
Promedio (1992-2002)	0.557		0.560	
Promedio (2002-2009)	0.538		0.545	

8. Conclusions

This paper attempted to analyze the consequences of the changes in labor regulation on labor markets outcomes and income distribution for Chile and Colombia. These two countries have undertaken different reforms regarding labor costs and hence the labor market outcomes have been dissimilar. Chile's structure of the non wage labor costs was modified during 1980s basically eliminating the labor costs different from wages in charge of the employee. As a result the trends of minimum labor costs of formal hiring have followed the minimum wage. The latter have soared in the last 20 years yet keeping itself around 40% of the per capita GDP. In the Colombian case, the labor costs in charge of the employee have sharply risen since the early 1990 as a result of larger social security contribution for health and pension in addition to the other non wage cost such as payroll taxes, bonuses and transportation subsidies. In this regard, the Colombian minimum wage have augmented nearly 40% in real terms from 1980 to 2009 yet falling from 70% to 60% of GDP per capita but the total labor costs –wage and non wage –have risen from 100% to 130% of per capita GDP since de mid 1990s to 2009. Thus, the index of labor costs has risen almost 43% since 1992.

We state in this paper that the a large parte of differences in the tendencies in labor outcomes in both countries such as informality, size of the workplace, wage gap and distribution of labor earnings have obeyed to the dynamic of labor costs. In fact, it is observed that in Chile informality rate –measured as affiliation to the pension system- has remained more or less constant around 36% since 1990. In addition, the informality gaps between skilled and non skilled workers have also remained invariable. Besides the percentage of the labor force working in large firms increase from 45% to 50% reducing the percentage in firms with 2 to 10 workers. Unlike Chile in Colombia it is observed a rise of the informality gap as the workers with college education exhibit as of 2009 less informality rates and the less skill ones more informality than in 1984 or 1992. Besides, the proportion of non skilled working in large firms has shrunk together with a drop of the share of the total labor force working in large firms. In fact, large firms (10 or more workers) had 42% of the labor force in 1994 and 37% in 2009.

So as to explain such divergent trends we developed a simple theoretical model and estimated an empirical one. The theoretical model pinpoints that a upsurge in the minimum costs of forma hiring unambiguously raises informality of the non skilled workers, depresses their wages and reduce the size of the informal firms. Simultaneous equations models were estimated using micro data for Chie and Colombia so as to capture the impact of the minimum costs of formal hiring on the probability of being informal and through that channel on the size of the workplace and labor earnings. After calculating the reduced forms we carried out a series of simulations founding that a large proportion of the labor markets outcomes –informality, firm size and labor earning distribution- are explained in the Colombian case by trends in labor costs. Thus, the simulations reveal that had the minimum costs of formal hiring kept at the 1992 level informality would have been 9 percentage points lower, the percentage of the labor force in large firms 6 percentage points higher and the Gini coefficient of labor earning 0.3 points lower. The impacts of the labor costs for Chile are much smaller as they have not changed as much during the last 20 years.

9. Appendix

Appendix A 1. Descriptive statistics of Chile.

		1990	1992	1994	1996	1998	2000	2003	2006	2009
Percentage of employed by education levels on companies of 11 or more workers	Elementary or less	33,1	35,8	33,9	30,8	34,0	32,1	32,7	37,0	36,6
	Incomplete High School	44,2	45,5	45,4	40,9	44,0	43,5	43,3	47,7	45,6
	High School	52,8	53,4	53,8	48,6	55,1	53,0	53,8	58,7	57,6
	Incomplete College or Tecnical education	63,4	66,2	66,0	59,0	64,3	63,3	64,7	68,0	68,0
	Complete College	75,4	73,5	76,2	70,6	76,0	74,6	76,0	78,4	77,2
Percentage of emplyed by education levels	Elementary or less	48,0	50,2	51,6	45,7	45,0	49,0	44,6	41,4	37,5
	Incomplete High School	17,6	17,2	15,6	17,7	17,1	15,5	15,4	15,0	14,1
	High School	19,8	20,5	20,5	22,9	23,8	23,4	25,9	29,1	33,1
	Incomplete College or Tecnical education	8,09	6,5	7,4	8,1	8,1	7,3	8,1	8,7	9,3
	Complete College	6,49	5,7	4,94	5,64	5,93	4,86	6,0	5,83	6,1

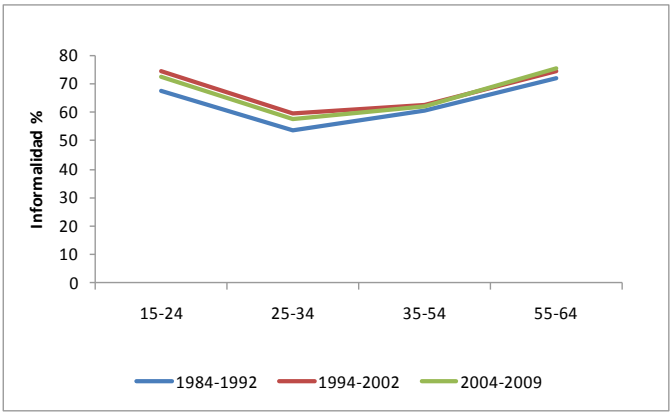
Appendix A 2. Descriptive statistics of Colombia.

		1984	1986	1988	1992	1994	1996	1998	2000	2002	2004	2006	2009
Percentage of employed by education levels on companies of 11 or more workers	Elementary or less	27,89	25,75	24,55	24,44	25,95	23,56	18,55	14,27	12,26	12,6	13,41	11,47
	Incomplete High School	41,93	39,71	37,06	37,8	39,52	35,8	27,77	24,71	19,83	19,85	21,19	18,39
	High School	59,96	56,4	54,25	54,38	54,72	53,39	46,69	42,32	39,37	39,43	39,61	38,06
	Incomplete College or Tecnical education	69,46	66,8	63,45	64,76	63,37	63,49	59,4	55,43	52,38	53,89	53,8	56,21
	Complete College	68,19	66,38	66,74	67,49	67,91	69,63	66,09	63,67	66,1	66,82	66,83	68,14
Percentage of emplyed by education levels	Elementary or less	45,41	43,36	40,9	36,21	33,51	32,36	32,19	31,09	29,36	27,68	25,46	24,6
	Incomplete High School	28,41	28,0	28,1	28,13	28,17	26,58	23,7	23,88	22,81	21,18	19,73	18,29
	High School	14,35	15,89	17,05	20,01	21,4	24,09	24,44	25,25	27,3	28,63	30,26	29,4
	Incomplete College or Tecnical education	5,53	5,68	6,12	6,93	7,32	6,79	8,23	8,54	8,4	9,35	10,41	13,42
	Complete College	6,3	7,07	7,83	8,72	9,59	10,18	11,44	11,24	12,13	13,15	14,14	14,29

Appendix A 3. Informality by age group of Colombia.

Strong informality definition			
Age group	**1984-1992**	**1994-2002**	**2004-2009**
15-24	67,54	74,37	72,39
25-34	53,62	59,73	57,64
35-54	60,69	62,70	62,25
55-64	71,70	74,20	75,21

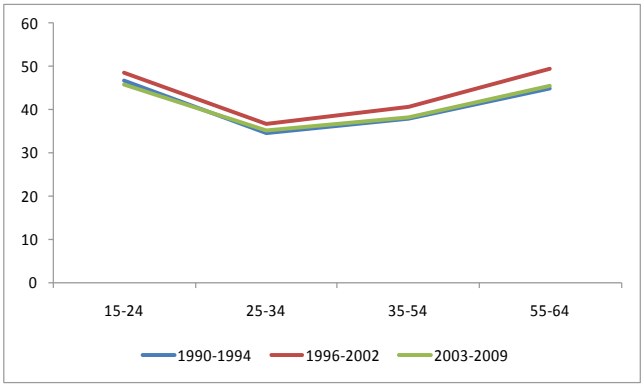
Appendix A 4. Informality by age group of Colombia.



Appendix A 5. Informality by age group of Chile

Strong Informality definition			
Age group	**1990-1994**	**1996-2002**	**2003-2009**
15-24	46,64	48,42	45,75
25-34	34,63	36,82	35,23
35-54	37,80	40,73	38,22
55-64	45,00	49,55	45,39

Appendix A 6. Informality by age group of Chile



Appendix A 7. Wage statistic of Colombia

Years	1984	1986	1988	1992	1994	1996	1998	2000	2002	2004	2006	2008	2009
Formal Workers	Formal workers wage	Formal workers wage	Formal workers wage	Formal workers wage	Formal workers wage	Formal workers wage	Formal workers wage	Formal workers wage	Formal workers wage	Formal workers wage	Formal workers wage	Formal workers wage	Formal workers wage
Elementary or less	922.735	895.012	914.313	823.895	1.038.258	896.369	835.618	599.920	614.566	624.426	726.688	654.088	607.337
Incomplete High School	1.121.766	1.022.566	945.787	917.858	1.115.118	965.263	993.782	704.938	674.743	687.755	731.037	656.643	633.525
High School	1.419.500	1.260.065	1.189.458	1.162.577	1.417.387	1.190.567	1.145.666	823.750	789.725	783.851	826.336	705.536	734.204
omplete College or Tecnical educat	1.791.581	1.626.584	1.529.239	1.515.559	1.732.008	1.711.848	1.683.264	1.119.113	1.118.597	1.042.028	1.054.276	927.787	899.360
Complete College	3.727.736	3.171.381	3.159.214	2.985.127	3.901.786	3.900.649	3.373.765	2.110.557	2.009.606	1.839.617	1.930.515	2.012.586	1.881.213
Informal Workers	Informal workers wage	Informal workers wage	Informal workers wage	Informal workers wage	Informal workers wage	Informal workers wage	Informal workers wage	Informal workers wage	Informal workers wage	Informal workers wage	Informal workers wage	Informal workers wage	Informal workers wage
Elementary or less	678.024	652.525	645.740	596.672	723.841	676.614	547.449	353.627	316.783	311.153	360.486	369.538	378.961
Incomplete High School	801.475	781.613	704.207	654.889	831.717	721.143	599.392	442.276	339.671	344.404	384.236	420.408	442.915
High School	1.275.694	1.116.870	1.040.982	949.806	1.304.758	955.393	841.803	546.722	453.467	436.065	462.733	487.373	498.862
omplete College or Tecnical educat	1.528.053	1.433.871	1.329.042	1.110.396	1.684.217	1.303.484	1.107.859	741.303	591.755	535.979	590.099	583.912	595.128
Complete College	2.811.482	2.600.935	2.350.021	2.246.245	3.377.304	2.464.791	2.617.024	1.346.239	1.212.213	1.016.138	1.080.528	1.311.665	1.395.340
Percentage of Informal workers													
Elementary or less	0,70	0,74	0,73	0,74	0,71	0,69	0,73	0,78	0,76	0,76	0,75	0,72	0,75
Incomplete High School	0,54	0,59	0,58	0,60	0,57	0,56	0,62	0,66	0,69	0,69	0,68	0,63	0,67
High School	0,32	0,36	0,36	0,36	0,36	0,34	0,41	0,45	0,47	0,46	0,45	0,42	0,44
omplete College or Tecnical educat	0,26	0,28	0,28	0,28	0,26	0,25	0,30	0,33	0,35	0,32	0,29	0,23	0,24
Complete College	0,23	0,25	0,23	0,19	0,21	0,17	0,21	0,22	0,18	0,16	0,14	0,13	0,13
Income gap by education levels with respect to Complete													
Elementary or less	4,68	4,24	4,14	4,33	4,66	4,92	5,15	4,76	4,82	4,44	4,00	4,29	4,17
Incomplete High School	3,71	3,44	3,69	3,74	3,98	4,43	4,31	3,65	4,22	3,78	3,65	3,79	3,60
High School	2,56	2,51	2,62	2,62	2,75	3,30	3,15	2,78	2,95	2,74	2,72	3,13	2,88
omplete College or Tecnical educat	2,04	1,93	2,02	2,03	2,21	2,28	2,13	1,96	2,00	1,94	1,97	2,27	2,20
Complete College	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Appendix A 8. Wage statistics of Chile

Years	1990	1992	1994	1996	1998	2000	2003	2006	2009
Formal Workers	Formal workers wage	Formal workers wage	Formal workers wage	Formal workers wage	Formal workers wage	Formal workers wage	Formal workers wage	Formal workers wage	Formal workers wage
Elementary or less	184.568	187.502	191.744	203.965	210.810	210.448	211.381	247.352	277.143
Incomplete High School	208.001	214.361	210.453	260.772	264.970	260.962	252.848	299.007	316.408
High School	304.055	302.540	311.860	317.754	310.993	303.341	297.560	322.190	354.054
Incomplete College or Tecnical education	432.457	459.258	453.248	515.162	562.775	525.230	557.879	563.304	566.334
Complete College	789.316	998.560	984.251	1.002.647	1.210.449	1.081.577	1.184.496	1.123.299	1.012.972
Informal Workers	Informal workers wage	Informal workers wage	Informal workers wage	Informal workers wage	Informal workers wage	Informal workers wage	Informal workers wage	Informal workers wage	Informal workers wage
Elementary or less	175.669	193.548	171.409	200.430	210.956	193.514	208.067	246.974	276.533
Incomplete High School	211.915	235.817	206.125	272.708	267.476	254.401	246.169	282.616	309.761
High School	345.885	379.051	332.755	367.207	385.045	313.615	318.419	320.486	340.411
Incomplete College or Tecnical education	492.124	655.935	592.214	624.441	724.079	580.097	555.259	556.766	554.179
Complete College	1.107.494	1.725.337	2.276.422	1.472.607	1.601.510	1.225.437	1.374.381	1.154.625	1.041.641
Percentage of Informal workers									
Elementary or less	0,45	0,52	0,53	0,54	0,55	0,59	0,56	0,50	0,49
Incomplete High School	0,36	0,40	0,40	0,40	0,43	0,47	0,45	0,40	0,41
High School	0,27	0,29	0,29	0,28	0,31	0,34	0,33	0,28	0,29
Incomplete College or Tecnical education	0,18	0,19	0,20	0,19	0,22	0,24	0,24	0,21	0,23
Complete College	0,12	0,14	0,12	0,15	0,16	0,17	0,16	0,15	0,16
Income gap by education levels with respect to Complete College									
Elementary or less	4,58	5,78	6,28	5,31	6,03	5,52	5,80	4,56	3,68
Incomplete High School	3,95	4,95	5,45	4,04	4,78	4,29	4,86	3,86	3,24
High School	2,63	3,40	3,57	3,24	3,81	3,60	3,99	3,51	2,91
Incomplete College or Tecnical education	1,87	2,22	2,36	2,00	2,13	2,05	2,18	2,01	1,81
Complete College	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Appendix A 9. Regression result of Colombia

```
reg3 (inf_pension dsize_4 yhat_formal_cmc1_pension yhat_formal_cmc1_2_pension int2_p int3_p
int4_p int5_p int2_2_p int2_3_p int2_4_p int2_5_p t_desempleo_ciudad $Xtodo)
(dsize_4 inf_pension lnw pc_lb_size10 t_desempleo_ciudad $Xd)
(lnw inf_pension dsize_4 educ edad edad_sq t_desempleo_ciudad $Xtodo) if lnw>0 & exp>=0 &
ftr001==1;

Three-stage least-squares regression
------------------------------------------------------------------------------
Equation           Obs  Parms        RMSE    "R-sq"       chi2        P
------------------------------------------------------------------------------
inf_pension    4.7e+05     47    .3886642    0.3570  191749.41   0.0000
dsize_4        4.7e+05     31    .4419737    0.1767  145742.03   0.0000
lnw            4.7e+05     41    2.827885   -8.1482   71052.99   0.0000
------------------------------------------------------------------------------
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
inf_pension  |
     dsize_4 |  -.8414688   .0033879  -248.37   0.000     -.848109   -.8348285
yh~1_pension |  -.1088604   .0042758   -25.46   0.000    -.1172409   -.1004799
y~_2_pension |   .0283968   .0013763    20.63   0.000     .0256993    .0310944
      int2_p |   .0709957   .0050096    14.17   0.000     .0611772    .0808143
      int3_p |   .0958917   .0054472    17.60   0.000     .0852154     .106568
      int4_p |   .1095522   .0058646    18.68   0.000     .0980579    .1210465
      int5_p |   .0874095   .0047428    18.43   0.000     .0781137    .0967052
    int2_2_p |  -.0203246   .0015489   -13.12   0.000    -.0233604   -.0172889
    int2_3_p |  -.0255097   .0015631   -16.32   0.000    -.0285733   -.0224461
    int2_4_p |  -.0297504   .0015469   -19.23   0.000    -.0327823   -.0267186
    int2_5_p |   -.026313   .0013924   -18.90   0.000    -.0290421   -.0235839
t_desemple~d |   .1006908   .0116771     8.62   0.000      .077804    .1235776
  dedad_niv2 |  -.0116357   .0005155   -22.57   0.000    -.0126461   -.0106253
  dedad_niv3 |  -.0149982   .0006546   -22.91   0.000    -.0162812   -.0137152
  dedad_niv4 |    -.01192   .0009568   -12.46   0.000    -.0137952   -.0100447
  dedad_niv5 |   .0000644   .0012867     0.05   0.960    -.0024575    .0025862
     deduc_2 |  -.0694195    .004038   -17.19   0.000    -.0773338   -.0615052
     deduc_3 |  -.1159378   .0051863   -22.35   0.000    -.1261029   -.1057728
     deduc_4 |  -.1389033   .0068182   -20.37   0.000    -.1522668   -.1255398
     deduc_5 |  -.1175283   .0060555   -19.41   0.000    -.1293969   -.1056597
     dyear_1 |  -.0033702    .003351    -1.01   0.315    -.0099381    .0031977
     dyear_2 |   .0169799   .0033113     5.13   0.000     .0104899      .02347
     dyear_3 |   .0068604   .0029572     2.32   0.020     .0010644    .0126564
     dyear_4 |   .0282885   .0030735     9.20   0.000     .0222646    .0343125
     dyear_6 |   .0691606   .0029772    23.23   0.000     .0633253    .0749959
     dyear_7 |   .0337215   .0031294    10.78   0.000     .0275881     .039855
     dyear_8 |   .0516459   .0034034    15.17   0.000     .0449753    .0583164
     dyear_9 |   .0474895   .0032718    14.51   0.000      .041077    .0539021
    dyear_10 |   .0313253   .0030537    10.26   0.000     .0253402    .0373104
    dyear_11 |   .0112811   .0029751     3.79   0.000     .0054499    .0171122
    dyear_12 |    .010177   .0041821     2.43   0.015     .0019802    .0183738
    dyear_13 |   .0104136   .0041168     2.53   0.011     .0023448    .0184825
     darea_1 |  -.0855858   .0051056   -16.76   0.000    -.0955925   -.0755791
     darea_2 |  -.0703609   .0045412   -15.49   0.000    -.0792615   -.0614604
     darea_3 |  -.0656355   .0044267   -14.83   0.000    -.0743116   -.0569594
```

```
     darea_4 |  -.0917786   .0051132   -17.95   0.000    -.1018003    -.081757
     darea_5 |  -.1436599   .0047558   -30.21   0.000     -.152981   -.1343388
     darea_6 |   -.065632   .0044976   -14.59   0.000    -.0744471   -.0568169
     darea_7 |  -.0527419   .0046482   -11.35   0.000    -.0618522   -.0436317
     darea_8 |   -.052083   .0048028   -10.84   0.000    -.0614964   -.0426696
     darea_9 |  -.0869295    .004789   -18.15   0.000    -.0963156   -.0775433
    darea_10 |  -.1268356   .0072277   -17.55   0.000    -.1410016   -.1126695
    darea_11 |  -.0455626   .0046638    -9.77   0.000    -.0547036   -.0364217
    darea_12 |   -.067658   .0071553    -9.46   0.000     -.081682   -.0536339
    darea_13 |  -.0796834   .0071097   -11.21   0.000    -.0936181   -.0657487
    darea_14 |   -.137796   .0069774   -19.75   0.000    -.1514715   -.1241206
    darea_15 |  -.0304907   .0057245    -5.33   0.000    -.0417105   -.0192709
       _cons |   .9680996   .0198581    48.75   0.000     .9291784    1.007021
-------------+----------------------------------------------------------------
dsize_4      |
 inf_pension |  -1.111119   .0061914  -179.46   0.000    -1.123254   -1.098984
         lnw |  -.0346057   .0021529   -16.07   0.000    -.0388254    -.030386
pc_lb_size10 |   .0602651   .0043312    13.91   0.000     .0517762     .068754
t_desemple~d |   .1142948   .0135105     8.46   0.000     .0878147    .1407749
     dyear_1 |   .0002345   .0038698     0.06   0.952    -.0073502    .0078191
     dyear_2 |   .0188449   .0038249     4.93   0.000     .0113482    .0263417
     dyear_3 |   .0057637   .0034204     1.69   0.092    -.0009401    .0124675
     dyear_4 |   .0274433   .0035544     7.72   0.000     .0204769    .0344098
     dyear_6 |   .0747447   .0034618    21.59   0.000     .0679597    .0815297
     dyear_7 |   .0311998   .0036151     8.63   0.000     .0241142    .0382853
     dyear_8 |   .0347313   .0039659     8.76   0.000     .0269583    .0425043
     dyear_9 |   .0272686   .0038283     7.12   0.000     .0197653    .0347719
    dyear_10 |   .0082071   .0035922     2.28   0.022     .0011664    .0152477
    dyear_11 |  -.0106721   .0034686    -3.08   0.002    -.0174704   -.0038739
    dyear_12 |  -.0151177   .0048699    -3.10   0.002    -.0246625   -.0055729
    dyear_13 |  -.0138746   .0047921    -2.90   0.004     -.023267   -.0044823
     darea_1 |  -.0895434    .005911   -15.15   0.000    -.1011287   -.0779581
     darea_2 |  -.0691974   .0052541   -13.17   0.000    -.0794953   -.0588995
     darea_3 |  -.0601481   .0051647   -11.65   0.000    -.0702708   -.0500254
     darea_4 |  -.0965711   .0059281   -16.29   0.000      -.10819   -.0849522
     darea_5 |  -.1505221   .0055444   -27.15   0.000    -.1613888   -.1396553
     darea_6 |  -.0641829   .0052041   -12.33   0.000    -.0743826   -.0539831
     darea_7 |  -.0546289   .0053726   -10.17   0.000    -.0651591   -.0440987
     darea_8 |  -.0472199   .0055682    -8.48   0.000    -.0581334   -.0363064
     darea_9 |  -.0860984   .0055416   -15.54   0.000    -.0969597   -.0752371
    darea_10 |  -.1288142   .0083632   -15.40   0.000    -.1452058   -.1124226
    darea_11 |  -.0415452   .0053902    -7.71   0.000    -.0521098   -.0309806
    darea_12 |  -.0683774   .0082715    -8.27   0.000    -.0845892   -.0521655
    darea_13 |  -.0774272   .0082199    -9.42   0.000     -.093538   -.0613165
    darea_14 |  -.1481854    .008076   -18.35   0.000     -.164014   -.1323568
    darea_15 |  -.0299816   .0066142    -4.53   0.000    -.0429453    -.017018
       _cons |   1.394287   .0393637    35.42   0.000     1.317135    1.471438
-------------+----------------------------------------------------------------
lnw          |
 inf_pension |   7.014432   .0923456    75.96   0.000     6.833438    7.195426
     dsize_4 |   5.686664   .0691083    82.29   0.000     5.551214    5.822114
        educ |   .1028864   .0013236    77.73   0.000     .1002922    .1054805
        edad |   .1142073   .0015122    75.52   0.000     .1112433    .1171712
     edad_sq |  -.0010802   .0000157   -68.77   0.000     -.001111   -.0010495
```

```
t_desemple~d |  -.6179448   .0466008   -13.26   0.000    -.7092807   -.5266089
  dedad_niv2 |   .1166993   .0058246    20.04   0.000     .1052832    .1281154
  dedad_niv3 |   .0244018   .0085514     2.85   0.004     .0076413    .0411622
  dedad_niv4 |     .03007    .011446     2.63   0.009     .0076363    .0525038
  dedad_niv5 |  -.0614828   .0158976    -3.87   0.000    -.0926415   -.0303241
     deduc_2 |  -.0049357   .0054406    -0.91   0.364    -.0155991    .0057277
     deduc_3 |   .2246909   .0084864    26.48   0.000     .2080579    .2413239
     deduc_4 |   .3919973   .0116924    33.53   0.000     .3690807    .4149139
     deduc_5 |     .77398   .0138226    55.99   0.000     .7468882    .8010718
     dyear_1 |   .1334587   .0132006    10.11   0.000      .107586    .1593315
     dyear_2 |  -.0789769   .0129771    -6.09   0.000    -.1044116   -.0535422
     dyear_3 |  -.0671664   .0115718    -5.80   0.000    -.0898466   -.0444862
     dyear_4 |  -.2958802   .0122682   -24.12   0.000    -.3199254    -.271835
     dyear_6 |  -.5490185   .0134563   -40.80   0.000    -.5753923   -.5226447
     dyear_7 |  -.4226898   .0129386   -32.67   0.000     -.448049   -.3973305
     dyear_8 |  -.9196172   .0145971   -63.00   0.000     -.948227   -.8910074
     dyear_9 |  -.9720541   .0140968   -68.96   0.000    -.9996833    -.944425
    dyear_10 |  -.8947259   .0128017   -69.89   0.000    -.9198167   -.8696351
    dyear_11 |  -.6550874    .011974   -54.71   0.000     -.678556   -.6316187
    dyear_12 |  -.7302646   .0165856   -44.03   0.000    -.7627718   -.6977573
    dyear_13 |  -.7083777   .0163394   -43.35   0.000    -.7404024    -.676353
     darea_1 |   .7916421   .0215522    36.73   0.000     .7494006    .8338836
     darea_2 |   .7749632   .0191085    40.56   0.000     .7375113    .8124151
     darea_3 |   .9766956   .0186057    52.49   0.000     .9402292    1.013162
     darea_4 |   .8221593   .0219914    37.39   0.000     .7790571    .8652616
     darea_5 |   1.324271   .0236222    56.06   0.000     1.277972    1.370569
     darea_6 |   .7829295    .018897    41.43   0.000      .745892    .8199669
     darea_7 |   .4885446     .01878    26.01   0.000     .4517364    .5253528
     darea_8 |   .7117192   .0194286    36.63   0.000     .6736398    .7497985
     darea_9 |   .9371219   .0207956    45.06   0.000     .8963633    .9778806
    darea_10 |   1.273314   .0310292    41.04   0.000     1.212498    1.334131
    darea_11 |   .5856332   .0188328    31.10   0.000     .5487216    .6225448
    darea_12 |   .6739513    .028712    23.47   0.000     .6176767    .7302258
    darea_13 |   .9032649   .0291334    31.00   0.000     .8461644    .9603654
    darea_14 |   1.126181   .0299208    37.64   0.000     1.067538    1.184825
    darea_15 |   .3388586   .0226217    14.98   0.000     .2945208    .3831964
       _cons |   3.734385   .1330128    28.08   0.000     3.473684    3.995085
------------------------------------------------------------------------------
Endogenous variables:  inf_pension dsize_4 lnw
Exogenous variables:   yhat_formal_cmc1_pension yhat_formal_cmc1_2_pension
     int2_p int3_p int4_p int5_p int2_2_p int2_3_p int2_4_p int2_5_p
     t_desempleo_ciudad dedad_niv2 dedad_niv3 dedad_niv4 dedad_niv5 deduc_2
     deduc_3 deduc_4 deduc_5 dyear_1 dyear_2 dyear_3 dyear_4 dyear_6 dyear_7
     dyear_8 dyear_9 dyear_10 dyear_11 dyear_12 dyear_13 darea_1 darea_2
     darea_3 darea_4 darea_5 darea_6 darea_7 darea_8 darea_9 darea_10
     darea_11 darea_12 darea_13 darea_14 darea_15 pc_lb_size10 educ edad edad_sq
```

Appendix A 10. Regression result of Chile

```
reg3  (d_inf_ss  d_cat_size4  yhat_formal_cmc1  yhat_formal_cmc1_2  int2  int3  int4int5  int2_2
int2_3 int2_4 int2_5 $Xtodo)
(d_cat_size4 d_inf_ss lnw pc_lb_size10 $Xd)
(lnw d_cat_size4 educ edad edad_sq $Xtodo) if lnw>0 & exp>=0 & o1==1;

Three-stage least-squares regression
------------------------------------------------------------------------------
Equation           Obs  Parms        RMSE    "R-sq"       chi2        P
------------------------------------------------------------------------------
d_inf_ss       5.4e+05     41    .4413699    0.1926  145919.17   0.0000
d_cat_size4    5.4e+05     25    .5130686   -0.0581   83382.45   0.0000
lnw            5.4e+05     34    .7631356    0.2792  220610.13   0.0000
------------------------------------------------------------------------------

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
d_inf_ss     |
 d_cat_size4 |  -.7010495   .0045274  -154.85   0.000    -.7099231    -.692176
yhat_forma~1 |  -.0698755   .0043097   -16.21   0.000    -.0783224   -.0614285
yhat_form~_2 |   .0073176   .0011243     6.51   0.000      .005114    .0095212
        int2 |  -.0067742   .0070479    -0.96   0.336    -.0205878    .0070395
        int3 |   .0008381   .0061652     0.14   0.892    -.0112456    .0129217
        int4 |   .0423749   .0048512     8.73   0.000     .0328666    .0518831
        int5 |   .0337983   .0053763     6.29   0.000      .023261    .0443357
      int2_2 |   .0031055   .0016509     1.88   0.060    -.0001302    .0063412
      int2_3 |   .0021138   .0013825     1.53   0.126    -.0005959    .0048235
      int2_4 |  -.0057007   .0011486    -4.96   0.000    -.0079519   -.0034495
      int2_5 |  -.0052249   .0011458    -4.56   0.000    -.0074706   -.0029792
 d_edad_niv2 |  -.0113779   .0008387   -13.57   0.000    -.0130217   -.0097342
 d_edad_niv3 |  -.0034839   .0010896    -3.20   0.001    -.0056195   -.0013482
 d_edad_niv4 |   .0118123   .0015438     7.65   0.000     .0087865     .014838
 d_edad_niv5 |   .0415391   .0023711    17.52   0.000     .0368918    .0461864
d_educ_niv~2 |   -.013953   .0074924    -1.86   0.063    -.0286379    .0007319
d_educ_niv~3 |  -.0554002   .0072683    -7.62   0.000    -.0696458   -.0411546
d_educ_niv~4 |  -.1341576   .0064056   -20.94   0.000    -.1467122   -.1216029
d_educ_niv~5 |  -.1347294   .0111625   -12.07   0.000    -.1566075   -.1128513
     d_year2 |   .0586156   .0032437    18.07   0.000      .052258    .0649732
     d_year3 |   .0636792   .0031328    20.33   0.000      .057539    .0698194
     d_year4 |   .0324117    .003276     9.89   0.000     .0259908    .0388325
     d_year5 |   .0811478   .0030676    26.45   0.000     .0751353    .0871602
     d_year6 |   .1022151   .0029748    34.36   0.000     .0963846    .1080456
     d_year7 |   .0933069   .0029453    31.68   0.000     .0875341    .0990797
     d_year8 |    .071394   .0029358    24.32   0.000     .0656399     .077148
     d_year9 |   .0848553   .0030285    28.02   0.000     .0789196     .090791
   d_region1 |   .0054684   .0160833     0.34   0.734    -.0260543     .036991
   d_region2 |  -.0011127   .0160694    -0.07   0.945    -.0326083    .0303828
   d_region3 |  -.0067338   .0161015    -0.42   0.676    -.0382922    .0248247
   d_region4 |   .0156846   .0159524     0.98   0.326    -.0155816    .0469508
   d_region5 |  -.0280397   .0158168    -1.77   0.076    -.0590401    .0029607
   d_region6 |  -.0293877   .0158816    -1.85   0.064    -.0605152    .0017397
   d_region7 |   .0214075   .0158471     1.35   0.177    -.0096521    .0524672
   d_region8 |   .0140428   .0157956     0.89   0.374    -.0169161    .0450016
```

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   d_region9 |   .0211047   .0158737     1.33   0.184    -.0100071    .0522165
  d_region10 |  -.0275991   .0158551    -1.74   0.082    -.0586745    .0034763
  d_region11 |  -.0431196   .0163626    -2.64   0.008    -.0751896   -.0110495
  d_region12 |  -.1426578   .0164235    -8.69   0.000    -.1748473   -.1104683
  d_region13 |   .0084833   .0157726     0.54   0.591    -.0224305    .0393971
  d_region14 |  -.0284079   .0182407    -1.56   0.119    -.0641591    .0073433
       _cons |   .8001441    .016469    48.58   0.000     .7678656    .8324227
-------------+----------------------------------------------------------------
d_cat_size4  |
    d_inf_ss |  -1.053068   .0064765  -162.60   0.000    -1.065761   -1.040374
         lnw |  -.0749209   .0019693   -38.05   0.000    -.0787806   -.0710612
pc_lb_size10 |   .2470981   .0056413    43.80   0.000     .2360413    .2581549
     d_year2 |    .127761   .0038599    33.10   0.000     .1201957    .1353263
     d_year3 |   .0708465   .0036021    19.67   0.000     .0637866    .0779064
     d_year4 |   .0436191   .0037716    11.57   0.000     .0362269    .0510114
     d_year5 |   .1017716    .003606    28.22   0.000     .0947039    .1088392
     d_year6 |   .1145638   .0035019    32.72   0.000     .1077003    .1214273
     d_year7 |    .108455   .0034664    31.29   0.000     .1016611     .115249
     d_year8 |   .0922592   .0034546    26.71   0.000     .0854883    .0990301
     d_year9 |   .1155916   .0036714    31.48   0.000     .1083957    .1227874
   d_region1 |  -.0043396   .0183092    -0.24   0.813     -.040225    .0315458
   d_region2 |  -.0092181   .0182916    -0.50   0.614    -.0450689    .0266327
   d_region3 |  -.0099126   .0183313    -0.54   0.589    -.0458413    .0260161
   d_region4 |   .0141028   .0181628     0.78   0.437    -.0214956    .0497012
   d_region5 |  -.0379088   .0180132    -2.10   0.035    -.0732139   -.0026036
   d_region6 |  -.0313429   .0180886    -1.73   0.083     -.066796    .0041101
   d_region7 |   .0203806   .0180438     1.13   0.259    -.0149847    .0557458
   d_region8 |   .0042346    .017989     0.24   0.814    -.0310232    .0394925
   d_region9 |   .0133231   .0180742     0.74   0.461    -.0221017     .048748
  d_region10 |  -.0315903    .018052    -1.75   0.080    -.0669716    .0037909
  d_region11 |  -.0434329   .0186278    -2.33   0.020    -.0799427   -.0069231
  d_region12 |  -.1524021   .0187112    -8.14   0.000    -.1890754   -.1157288
  d_region13 |   -.001051   .0179608    -0.06   0.953    -.0362535    .0341516
  d_region14 |  -.0359876    .020771    -1.73   0.083    -.0766981    .0047228
       _cons |   1.614263   .0318693    50.65   0.000     1.551801    1.676726
-------------+----------------------------------------------------------------
lnw          |
 d_cat_size4 |   .2812152   .0088246    31.87   0.000     .2639193    .2985111
        educ |    .056608   .0006437    87.95   0.000     .0553465    .0578695
        edad |   .0386363   .0010981    35.19   0.000     .0364841    .0407885
     edad_sq |  -.0002207   .0000124   -17.79   0.000    -.0002451   -.0001964
 d_edad_niv2 |   .0539562   .0054408     9.92   0.000     .0432924    .0646199
 d_edad_niv3 |   .0262331   .0084579     3.10   0.002     .0096558    .0428103
 d_edad_niv4 |  -.0018439   .0103421    -0.18   0.858     -.022114    .0184262
 d_edad_niv5 |   .0829594   .0130567     6.35   0.000     .0573688    .1085499
d_educ_niv~2 |   .0030271   .0041462     0.73   0.465    -.0050994    .0111536
d_educ_niv~3 |   .0799584   .0049136    16.27   0.000      .070328    .0895888
d_educ_niv~4 |   .3042265    .007374    41.26   0.000     .2897737    .3186793
d_educ_niv~5 |   .6926742   .0092126    75.19   0.000     .6746178    .7107306
     d_year2 |   .1121978   .0056957    19.70   0.000     .1010345    .1233611
     d_year3 |   .0874619   .0054976    15.91   0.000     .0766869    .0982369
     d_year4 |   .1725708   .0057528    30.00   0.000     .1612956     .183846
     d_year5 |   .2136492   .0053878    39.65   0.000     .2030893    .2242091
     d_year6 |    .150589   .0052149    28.88   0.000     .1403679    .1608101
```

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     d_year7 |   .1623939     .00517    31.41   0.000     .1522608    .1725269
     d_year8 |   .2346744   .0051664    45.42   0.000     .2245485    .2448004
     d_year9 |   .3510652   .0053407    65.73   0.000     .3405976    .3615328
    d_region1 |  -.0369357   .0282413    -1.31   0.191    -.0922877    .0184163
    d_region2 |   .1109334   .0282114     3.93   0.000     .0556401    .1662268
    d_region3 |  -.0105327   .0282793    -0.37   0.710     -.065959    .0448936
    d_region4 |  -.1807479   .0280107    -6.45   0.000    -.2356479   -.1258479
    d_region5 |  -.1177116   .0277746    -4.24   0.000    -.1721488   -.0632743
    d_region6 |  -.1590576    .027892    -5.70   0.000    -.2137249   -.1043903
    d_region7 |  -.2086473   .0278254    -7.50   0.000    -.2631842   -.1541105
    d_region8 |  -.2436431   .0277349    -8.78   0.000    -.2980025   -.1892837
    d_region9 |  -.2463909   .0278712    -8.84   0.000    -.3010174   -.1917644
   d_region10 |  -.0342094   .0278432    -1.23   0.219    -.0887809    .0203622
   d_region11 |    .159897   .0287312     5.57   0.000     .1035849    .2162091
   d_region12 |   .1737191   .0288305     6.03   0.000     .1172124    .2302258
   d_region13 |   .0169406   .0276985     0.61   0.541    -.0373475    .0712286
   d_region14 |  -.1098235   .0320308    -3.43   0.001    -.1726028   -.0470443
        _cons |   10.22011   .0334264   305.75   0.000     10.15459    10.28562
------------------------------------------------------------------------------
Endogenous variables:  d_inf_ss d_cat_size4 lnw
Exogenous variables:   yhat_formal_cmc1 yhat_formal_cmc1_2 int2 int3 int4
     int5 int2_2 int2_3 int2_4 int2_5 d_edad_niv2 d_edad_niv3 d_edad_niv4
     d_edad_niv5 d_educ_nivel2 d_educ_nivel3 d_educ_nivel4 d_educ_nivel5
     d_year2 d_year3 d_year4 d_year5 d_year6 d_year7 d_year8 d_year9
     d_region1 d_region2 d_region3 d_region4 d_region5 d_region6 d_region7
     d_region8 d_region9 d_region10 d_region11 d_region12 d_region13
     d_region14 pc_lb_size10 educ edad edad_sq
------------------------------------------------------------------------------
```

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